



**CLASS I NON-HAZARDOUS WASTE INJECTION WELL
APPLICATION FOR SUBSURFACE DISPOSAL
OF NON-HAZARDOUS LIQUID INDUSTRIAL WASTE**

Submit to:
Kansas Department of Health Environment
Division of Environment
Bureau of Water
Geology Section
1000 SW Jackson St. Suite 420
Topeka, Kansas 66612-1367

Owner's Name, Telephone Number,
Mailing and E-Mail Addresses:

Operator's Name, Telephone Number,
Mailing and E-Mail Addresses:

Contact Person's Name and Mailing
Address:

Date of Application: _____
KDHE UIC Permit No.: _____

Well (s)# _____

Legal Description: ____1/4 ____1/4 ____1/4
____Sec. _____, T _____ S, R _____ (E) (W)
_____ feet from south line of SE/4
_____ feet from east line of SE/4

County _____

G.P.S. Coordinates:

Latitude _____ Longitude _____

Located on Indian lands: Yes____ No____

Facility Name, Telephone Number, Mailing
and E-Mail Addresses:

Contact Person's Information:

Phone: _____
Fax: _____
E-mail: _____

In conformity with the provisions of K.S.A. 65-171d, the undersigned, representing

(Name of company, corporation, partnership, or person, or government or other public agency
applying)

hereby makes application to KDHE for a permit to dispose of liquid wastes into the subsurface by means
of a disposal well.

The application should address the following items in numerical order.

1. Provide documentation all required local approvals have been obtained.
2. List any permits or construction approvals received or applied for by the facility which are required under any of the following programs
 - ! Hazardous Waste Management program under the Resource Conservation Recovery Act (RCRA).
 - ! Underground Injection Control program under the Safe Drinking Water Act.
 - ! National Pollutant Discharge Elimination System program under the Clean Water Act
 - ! Prevention of Significant Deterioration (PSD) program under the Clean Air Act
 - ! Nonattainment program under the Clean Air Act
 - ! National Emission Standards for hazardous Pollutants (NESHAPS) preconstruction approval under the Clean Air Act.
 - ! Dredge and fill permits under section 404 of Clean Water Act.
 - ! Other relevant environmental permits, including State permits.
3. Provide up to four Standard Industrial Classification (SIC) codes which best reflect the principal products or services provided by the facility.
4. Describe all liquid waste to be disposed of, including physical, chemical, bacteriological and radiological properties and toxicity. Provide analyses for each waste stream including analyses for all constituents listed in Attachment A. Include Material Safety Data Sheets (MSDS) for any additives used. All analyses shall be conducted by a laboratory certified by the State of Kansas. Additional testing of the waste stream may be required after review of the application and pertinent information.
5. Provide a demonstration that each individual waste stream is not hazardous as defined by RCRA. This includes documentation that the waste is not a listed hazardous waste or a characteristic hazardous waste. The applicant makes the demonstration by evaluating the waste against a list of exempted wastes, the four lists of hazardous wastes (F, K, P, & U Lists) and the four characteristics of:
 - ! ignitability
 - ! corrosivity
 - ! reactivity
 - ! toxicity

KDHE's Bureau of Waste Management can be contacted at (785) 296-1600 for assistance.

Describe the procedures and methods used to obtain representative samples of the waste stream(s). Include a description of the following:

- ! location where the samples were collected
- ! the method used to collect the samples
- ! sample containers
- ! sample storage
- ! transportation of samples
- ! chain of custody
- ! quality assurance/control procedures used

6. Describe the sources, including individual processes, generating the various waste streams that are proposed to be injected. Provide a waste flow block diagram depicting the relationship of the sources to the proposed disposal well. Include all waste sources and estimated quantities of waste produced by each source. An example of an acceptable diagram format is attached.
7. Describe the current disposal method(s) for the waste(s) that is proposed to be injected.
8. The use of industrial-waste disposal wells is considered only for those wastes for which it is not feasible to treat the waste and dispose by other means. On this basis, include a report of the results of studies of alternative treatment and disposal technologies and a justification of why subsurface disposal is considered the best method for disposal of the waste. Include a detailed cost estimate and a description of benefits and risks for each alternative. The report must address the requirements of the KDHE policy entitled **“Determination of the Types of Waste Eligible for Disposal into a Class I UIC Disposal Well”**. (A copy of the policy is attached.)
9. Provide a waste handling contingency plan for coping with well failure or shut-in of the well. Include a detailed description of any facilities used for this purpose.
10. Provide the following: (Guidance for completing this section is attached.)

Note: Seismic data may be necessary to characterize the subsurface geology if there is insufficient well control in the area.

- a. Provide discussion and supportive information demonstrating drilling the disposal well and injecting industrial waste into the subsurface stratum will not endanger or injure any mineral resources (coal, oil, gas, salt, sand, gravel, others) bearing formations. Include maps and sources for other supporting information.
- a. A map indicating the boundaries and ownerships of tracts of land adjacent to the applicant's facility boundaries. Include a list of the names and mailing addresses of all owners of tracts of land adjacent to the plant boundaries keyed to the map.
- b. Identify and provide a complete mailing address for all mineral resource owners that may be affected by the migration of injection waste over the life of the well. Specify the total percentage owned by all persons identified.

- c. A USGS topographic map indicating the facility boundaries and well location. Include on this map an outline of the one (1) mile radius area of review.
- d. Provide a clear, readable detailed map with an appropriate scale. The one mile radius area of review must be drawn on the map.

- ! the injection well to be permitted
- ! all oil and gas producing wells
- ! all inactive wells
- ! injection wells
- ! abandoned wells
- ! dry holes
- ! plugged wells
- ! core holes
- ! surface water bodies
- ! springs
- ! mines
- ! quarries
- ! water wells
- ! monitoring wells
- ! faults
- ! other pertinent surface features

Provide a tabulation of data for all wells penetrating the injection zone and/or the confining zone within the area of review including the following:

- ! current status
- ! type
- ! construction
- ! date of drilling
- ! location
- ! depth
- ! plugging or completion data

Key these wells to the map. Copies of plugging records for wells penetrating the injection zone and/or the confining zone shall be provided if available. **A schematic indicating the current configuration of all wells penetrating the injection zone and/or confining zone shall be submitted on the attached forms.** Provide proposed corrective measures required for wells in the area of review, if any.

- e. Describe the protocol used to identify, locate and ascertain the condition of all wells within the area of review. At a minimum the records of the following shall be reviewed:

- ! Kansas Department of Health and Environment
- ! Kansas Geological Society
- ! Kansas Geological Survey
- ! Kansas Corporation Commission

Provide documentation that these sources were checked. Appropriately scaled aerial photos of the area of review shall also be examined for any indication of wells and the results reported. Copies of the aerial photos examined shall also be submitted. In addition, the location of each abandoned well penetrating the injection zone shall be physically inspected. The results of this inspection shall be documented and submitted to KDHE.

- f. Provide surface geologic maps, cross sections, and structural contour maps illustrating the regional geologic setting.
- g. Provide two cross-sections perpendicular to each other crossing at the proposed injection well location. These cross-sections shall include, at a minimum, available wire-line logs, geologic units and lithology from the surface to the base of the injection zone. The lines of the cross-sections should be shown on all structure maps. The cross sections should contain the well numbers from the area of review map for reference.
- h. Provide maps and cross-sections indicating the general vertical and lateral limits of all aquifers containing less than 10,000 mg/l total dissolved solids within the area of review, their position relative to the zone of injection and the direction of water movement if known. (i.e. groundwater flow map) All maps should include the area of review.
- i. Provide detailed discussion of the nature and areal development of upper and lower confining strata (lithology, permeability, etc.).
- j. Provide descriptions and maps of faulting and fracturing or lineations in the area and discussion of the seismic history and activity of the area.
- k. Provide depositional and structural history of the area including lithology and hydrologic properties of all units penetrated by the proposed well.
- l. Provide the following maps for the area using available well control:
 - ! Structural contour map of the injection zone
 - ! Isopach map of the injection zone
 - ! Structural contour map of the confining zone
 - ! Isopach map of confining zone
- m. Provide a piezometric surface map of the injection zone or, if insufficient data is available,

provide the expected static fluid level and regional gradient. Reference sources of this information and include the area of review on the map.

- n. Provide a description of porosity, permeability, and temperature of the injection interval and chemical characteristics of the injection interval fluid. Reference sources of this information.
- o. Provide the predicted fracture pressure of injection interval. Provide the calculations and methodology used to determine the fracture pressure. Reference the sources of values used. One example of an acceptable equation for calculating the predicted fracture pressure is the Eaton Equation, as follows:

$$F = \left(\frac{S - P}{D} \right) \left(\frac{\nu}{1 - \nu} \right) + \frac{P}{D}$$

P = wellbore pressure, psi

D = depth, ft

S = overburden stress, psi

ν = Poisson's ratio

F = fracture gradient, psi/ft

- p. Calculate the predicted injection zone pressure build-up within a one (1) mile radius of the proposed injection wellbore. Provide a pressure contour map for the area of review. Include calculation, equations, parameters and sources of information used to arrive at the predicted pressure build-up. This should be calculated for the expected life of the injection well. The effects of other wells injection into the same injection zone within the vicinity of the proposed well shall also be considered.
- q. Calculate the cone of influence. Provide a map showing the cone of influence. The cone of influence is defined as that area around the well within which increased injection zone pressures caused by injection into the injection well would be sufficient to drive fluids into a source of fresh and usable water. Include calculations, equations, parameters, and sources of information used to determine the cone of influence. This should be calculated for the expected life of the well.
- r. Calculate the predicted distance of wastewater flow from the injection well. Include calculations, equations, parameters and sources of information used. This should be calculated for the expected life of the well. An acceptable equation for calculating this comes from Warner and Lehr, Subsurface Wastewater Injection, Premier Press, 1981 and is as follows:

$$r = \sqrt{\frac{V}{p b j}}$$

r = radial distance of wastewater front from well
 V = Qt = cumulative volume of injected wastewater
 b = Arbuckle thickness
 f = average porosity

11. Provide a report discussing the anticipated compatibility of the waste stream with both the interstitial fluids and formation minerals in the injection zone and the confining zone at expected temperature and pressures. The report should include anticipated reaction products. **Common reactions are listed in the attached Guidance for Compatibility Study for Class I Disposal Wells.** Reference the sources of this information.
12. Provide a plan for conducting a study of compatibility of the waste with the interstitial fluids and formation minerals in the injection zone and the confining zone. **(Guidance for Compatibility Study for Class I Disposal Wells is attached.)** Include the name of the laboratory that will be used for any core sample analysis and formation fluid testing.
13. Provide a report on the results of a corrosion test on all injection well components and appurtenances which will be in contact with the waste stream. Include the name of the manufacturer of the components. All materials must be compatible with the waste which the materials may be expected to come into contact. The materials shall be deemed to have compatibility as long as the materials meet or exceed standards developed for such materials by the American Petroleum Institute, the American Society for Testing Materials or comparable standards. Include a description of the methodology and procedures used to conduct the test and to make the compatibility determination. Include the manufacturer's test date for the injection tubing.

14. Injection Zone:

Formation(s) Name	Estimated Depth of Top*	Estimated Depth of Base*

Injection Interval:

Perf/Openhole _____ to _____, _____ to _____, _____ to _____*

*Provide reference point for these values.

15. Top hole elevation _____ (Top hole elevation of the proposed disposal well, with a closed traverse from U.S.G.S. or approved bench mark tied to the U.S.G.S. bench mark system.)

16. Well Completion:

Provide borehole, casing, tubing, packer and cement information. The tubing and packer for new wells shall be new. Surface casing and longstring casing for new wells shall be new and cemented bottom to top by circulating. Sufficient cement shall be used to circulate to surface plus a minimum of 20% excess. The well shall be cased and cemented such that: 1) injection fluids and injection zone or other formation fluids do not cause deterioration of the water quality of fresh and/or usable water zones, 2) the loss of fresh and/or usable water due to downward migration is prevented, and 3) the release of injection fluids into an unauthorized zone is prevented.

Borehole size	Casing/ Tubing size	Material	Weight lbs/ft	Casing seat depth	Joint lengths	Type Cement	Amount cement (sacks)	Cemented interval from	to

Packer Grade and Type _____ Estimated Packer Setting Depth _____*

*Provide reference point for these values.

17. Describe the maximum burst pressure, collapse pressure and tensile stress which may be experienced including calculations, methodology and references used to determine these. Provide the calculations, formulas, equations and methodology used to determine the casing, cementing, tubing, and packer are designed to tolerate the pressures or forces anticipated to be encountered or exerted on the well during construction, completion and operation. Include design factors used and provide references. The casing burst pressure, casing collapse pressure and the casing tension shall be calculated using performance properties listed in American Petroleum Institute (API) Bulletin 5C2. Well casing shall meet the specifications set out in API Specification 5CT. Submit service company recommendations along with studies to determine the suitability of the selected cements. Describe the type, grade, additives, slurry weight and expected compressive strength of the cement. Describe the cementing techniques and equipment including guide shoe, float collar, plugs, baskets, D V tools and their location. Describe the number and location of centralizers, wall scratchers, etc. Describe in detail the procedures to be used to

ensure satisfactory cementing of the various casings and the remedial action to be taken if primary cementing results are not satisfactory.

18. Annulus Monitoring System:

The annulus between _____ and _____ (pipe size) is to be monitored for leaks. Type of liquid in annulus _____. Proposed minimum annulus pressure is _____ psig. **(The minimum approvable annulus pressure is 40 psig.)** Provide an MSDS for any additives in the annulus liquid. **Provide design plans for the annulus seal pot monitoring system. (An acceptable design example is attached.)**

19. Liquid Injection Rate:

Liquid wastes to be injected at a minimum rate of _____ gallons/day to a maximum rate of _____ gallons/day. Provide a demonstration that the maximum injection rate is feasible.

20. Injection Pressure:

Disposal will be by means of gravity pressure (no pump pressure allowed) or _____ inches vacuum.

21. Discuss the proposed injection procedure for the well. Submit a flow diagram.

22. Surface Facilities:

Describe and provide design information and diagrams for all surface retention facilities, holding tanks, lines, transfer pumps and filters associated with the injection operation.

23. Spill Prevention:

Provide a detailed spill prevention and containment plan for the injection operation. Provide design plans for any spill containment structure(s).

24. Environmental Remedial Action:

Should fresh or usable water or the soils become contaminated by a failure of the injection facilities, the permittee is responsible for investigating the contamination and any required remediation of the contamination. The permittee will be required to sign an agreement with KDHE which will establish guidelines and objectives for investigation and remediation of the contamination. Provide acknowledgment of this requirement.

25. Discuss how monitoring requirements for the injection operation will be met. Electronic continuous recording devices and gauge or meters are required to monitor tubing pressure, flow rate, volume and

- annulus pressure. Describe the meters or gauges and continuous recording devices that will be used to measure and record injection volume, injection rate, annulus pressure and tubing vacuum.
26. Provide a diagram indicating the location of all monitoring devices. Provide a quality assurance/quality control plan for obtaining reliable monitoring data. This includes method of calibration and frequency of calibration of gauges, meters and continuous recording devices. Include a waste analysis plan that describes the procedures and methods to be used to obtain representative samples of the waste to meet monitoring requirements.
 27. Describe where the injection fluid samples will be collected, the method used to collect the samples, sampling containers, sample storage, chain of custody procedures and the quality assurance/control procedures used. All analyses required by the UIC permit shall be conducted by a laboratory certified by the State of Kansas.
 28. Provide a certificate of means of financial assurance the well will be properly plugged and abandoned at the end of its useful life or when required by KDHE to protect the human health, fresh and/or usable waters or soils. This should include all injection wells owned by the applicant. **(Procedures for Demonstrating Financial Assurance for a Class I Disposal Well is attached.)**
 29. Provide a plugging and abandonment plan for the well. Include a diagram. Describe the type, grade, quality and estimated quantity of cement to be used in plugging. Describe the method of cement placement. Provide three cost estimates for plugging the well. **(Procedures for the Plugging and Abandonment of a Class I Non-Hazardous Waste Disposal Well-Longstring Cemented from Bottom to Surface is attached. An example diagram is also included.)**
 30. Provide a detailed plan for the testing program to determine the injection zone properties such as static fluid level, fluid pressure, and temperature.
 31. Describe the procedure to be used to obtain a representative sample of the injection zone fluid. Describe the quality assurance/quality control that will be exercised in the collection, storage and transportation of the sample to a Kansas certified laboratory for analysis. Provide the name of the laboratory that will conduct the analyses. A list of the constituents which the sample shall be analyzed is attached.
 32. Provide a schematic indicating the proposed well completion at the surface and subsurface.
 33. Discuss the proposed injection interval stimulation program including fracture methods and chemical treatments.
 34. Provide a plan for conducting the temperature log or oxygen activation log which is required to check for the absence of significant fluid movement behind the longstring casing. **(Procedures for the Temperature Log Test Procedure for Determining External Mechanical Integrity of a Class I Non-Hazardous Disposal Well and Guidelines for the Oxygen Activation Log Procedure for Determining External Mechanical Integrity of a Class I Non-Hazardous Disposal Well are attached.)**

35. Provide a plan for pressure testing the tubing/casing annulus for mechanical integrity. **(Procedures for the Pressure Mechanical Integrity Test Procedure for Determining Internal Mechanical Integrity of a Class I Disposal Well Completed with Tubing and Mechanical Packer is attached.)**
36. Provide a plan for conducting the pressure fall-off test that is required to determine injection zone characteristics. **(Procedure for Conducting a Formation Pressure Fall-Off Test for a Class I Disposal Well and Developing a Test Plan are attached.)**
37. Discuss how drilling fluids and the formation cuttings will be contained and managed to prevent fresh water or soil contamination. Describe the dimensions of the drilling tank and the reserve tank. Provide a plan describing how the liquid and solid contents of the drilling tank will be disposed. Provide a plan describing how the fluids and formation cuttings in the reserve tank will be disposed.
38. Provide a drilling prognosis for the well. This should include at a minimum the setting of casing, cementing, logging, coring and testing.
39. Describe the rock coring program. Include a representative well log with proposed core intervals indicated. At the minimum a core of a representative shale in the confining zone and a core of the injection zone must be obtained.
40. Describe the core testing procedures. The cores shall be analyzed for permeability, porosity and density and the lithology shall be described.

In addition, the permit will not become fully effective until the following have been received and approved by KDHE.

- A. A complete set of logs of the well. New wells should have a minimum of the following logs or similar type logs. An interpretation of the logs by a person with the technical expertise to interpret the logs shall also be submitted.

Surface Bore Hole:

1. Caliper
2. Resistivity
3. Spontaneous Potential

Surface Casing:

4. Cement Bond and Variable Density

Longstring Bore Hole (including borehole below longstring casing):

5. Resistivity
6. Spontaneous Potential
7. Directional or Inclination Survey
8. Caliper
9. Gamma Ray-Neutron-Compensated Density
10. Fracture Finder

Longstring Casing:

11. Cement Bond
 12. Caliper and Electromagnetic Casing Inspection
- B. Complete casing and cementing information. Including cementing tickets, pipe tallies, work reports, and a drilling and completion history.
- C. A chemical analysis of the injection interval fluid. Include partial chemical, heavy metals, VOC, temperature and pH analyses. All analyses shall be conducted by a laboratory certified by the State of Kansas.
- D. A discussion of the injection interval characteristics. Include fluid pressure and temperature and describe the lithology of the injection zone. A core of the injection interval must be taken and the permeability, porosity and density described.
- E. Results of the pressure fall-off tests including an interpretation by a person with the technical expertise to evaluate the data.
- F. A static fluid level measurement of the injection interval.
- G. A description of the characteristics of the confining zone. A core of the confining zone must be taken and the permeability, porosity and density described.
- H. Supply a schematic drawing showing the actual well completion at the surface and subsurface, if different from the proposal.
- I. Results and interpretation of a test of compatibility between the fluids to be injected and the injection interval fluids and matrix minerals at expected temperature and pressure.
- J. Revised calculations of predicted reservoir pressure build-up at a 1 mile radius from the injection well based on actual injection zone properties determined from the formation testing program. Include calculations, equations and parameters. This should be calculated for the expected life of

the well.

- K. Revised calculations of the cone of influence based on actual injection zone properties determined from the formation testing program. Include calculations equations and parameters. This should be calculated for the expected life of the well.
- L. Revised calculation of distance of wastewater flow from the injection well based on actual injection zone properties obtained from formation testing program.
- M. Results of annulus pressure test and the test to check for fluid migration behind the casing. Results shall be submitted in the format described in Departmental guidelines.

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information. K.A.R. 28-46-22 requires this certification and this application be signed by a responsible corporate officer, such as President, Secretary, Treasurer or Vice-President of the corporation or other authorized signatory as described at the Code of Federal Regulations 40 CFR 144.32.

Printed Name of Authorized Signatory

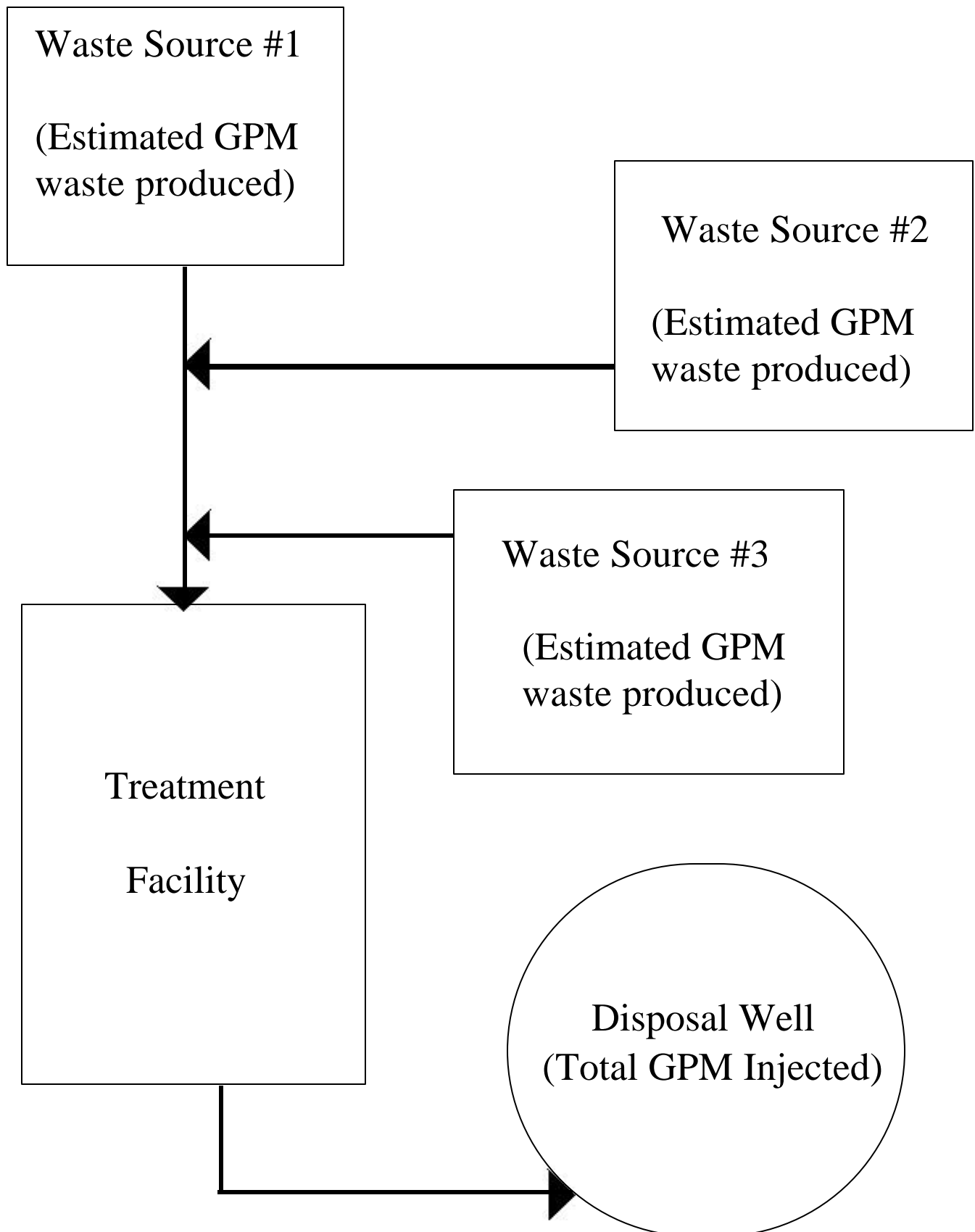
Signature of Authorized Signatory

Company

Title

Effective: 12/20/02

TYPICAL BLOCK DIAGRAM



ATTACHMENT "A"

COMPOUNDS REQUIRING ANALYSIS FOR CLASS I DISPOSAL WELLS

1. VOLATILE ORGANIC

COMPOUNDS (Method 624-Purge & Trap GC/MS) Detection limits nominally 10 ug/L for Acrolein and Acrylonitrile at 100 ug/L

Acrolein
Acrylonitrile
Benzene
Bromomethane
Bromodichloromethane
Bromoform
Carbon Tetrachloride
(Tetrachloromethane)
Chlorobenzene
Chloroethane
2-Chloroethylvinyl ether
Chloroform
Chloromethane (Methylchloride)
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
trans-1,2-Dichloroethane
1,2-Dichloropropane
cis-1,3-Dichloropropane
trans-1,3-Dichloropropane
Ethylbenzene
Methylene chloride
(dichloroemethane)
1,1,2,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
Toluene
Vinyl Chloride

2. ACID ORGANIC COMPOUNDS

(Method 625-Extractions GC-MS Detection limits nominally 25 ug/L except for dinitro compounds at 250 ug/L

4-Chloro-3-methylphenol
2-Chlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2-Methyl-4,6- dinitrophenol
2-Nitrophenol
4-Nitrophenol
Pentachlorophenol
Phenol
2,4,6-Trichlorophenol

3. BASE/NEUTRAL ORGANIC

COMPOUNDS (Method 625-Extraction GC/MS) Detection limits nominally 10 ug/L

A. Polynuclear Aromatics
Acenaphthene
Acenaphthylene

Anthracene
Benzo (a) anthracene
Benzo (b) fluoranthene
Benzo (a) fluoranthene
Benzo (a) pyrene
Benzo (g,h,i) perylene
Chrysene
Dibenzo (a,h) anthracene
Fluoranthene
Fluorene
Indeno (1,2,3-cd) pyrene
Naphthalene
Phenanthrene
Pyrene

B. Ethers & Esters

Bis (2-chloroethyl) ether
Bis (2-chloroethoxy) methane
Bis (2-ethylhexyl) phthalate
Bis (2-chloroisopropyl) ether
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
4-Chlorophenyl phenyl ether
Diethylphthalate
Dimethylphthalate
Diethylphthalate
Di-n-butylphthalate
Isophorone

C. Nitrogen Containing

Compounds
Benzidine
2,4-Dinitrotoluene
2,6- Dinitrothlune
1,2- Diphenylhydrazine
Nitrobenzene
N-Nitrosodimethylamine
N-Nitrosodi-n-proplamine
N-Nitrosodiphenylamine

D. Chlorinated Hydrocarbons

2-Chloronaphthalene
1,3-Dichloronbenzene
1,4-Dichloronbenzene
1,2-Dichloronbenzene
3,3-Dichloronbenzidine
Hexachlorobenzene
Hexachlorobenzidine
Hexachloroethane
Hexachlorocyclopentadiene
2,3,7,8-Tetrachlorodibenzo-p- dioxin
1,2,4-Trichlorobenzene

4. PESTICIDE COMPOUNDS

(Method 625-Extraction GC/EC) Detection limits nominally 0.01ug/L

Aldrin
a-BHC
β-BHC
d-BHC

?-BHC
Chlorodane
4,4'-DDD
4,4'DDD
4,4'DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Aldehyde
Heptachlor Expoxide
Toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

5. HEAVY METALS

Antimony
Arsenic
Beryllium
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Zinc

6. MISCELLANEOUS

Cyanides
Phenols

7. GEOCHEMICALS

Total Hardness (CaCO₃)
Calcium
Sodium
Magnesium
Potassium
Total Alkalinity
Chloride
Sulfate
Fluoride
Nitrate
Iron
Manganese
Ammonia
Phosphate
Silica
Specific Conductance
Total Dissolved Solids
Total Suspended Solids
Oil and Grease

ATTACHMENT "A" (continued)
TCLP REQUIREMENTS

The following constituents are regulated under the Toxicity Characteristic rule. The Waste Stream must be analyzed for these constituents using the Toxicity Characteristic Leaching Procedure (TCLP).

Benzene
Carbon tetrachloride
Chlordane
Chlorobenzene
Chloroform
m-Cresol
o-Cresol
p-Cresol
1,4- Dichlorobenzene
1,2- Dichloroethane
1,1 Dinitrotoluene
2,4- Dinitrotoluene
Heptachlor (and its hydroxide)
Hexachloro-1,3-butadiene
Hexachlorobenzene
Hexachloroethane
Methylethylketone
Nitrobenzene
Pentachlorophenol
Pyridine
Tertachloroethylene
Trichloroethylene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Vinyl chloride
Arsenic
Barium
Cadmium
Chromium
Lead
Mercury
Selenium
Silver
Endrin
Lindane
Methoxychlor
Toxaphene
2,4-Dichlorophenoxyacetic acid
2,4,5-Trichlorophenoxypropionic acid



State of Kansas

Joan Finney, Governor
Department of Health and Environment
Division of Environment

Stanley C. Grant, Ph.D., Secretary

Forbes Field, Bldg. 740, Topeka, KS 66620-0001

Respond 10912-296-3560
FAX (913) 296-6247

FROM: Karl W. Mueldener, P.E.
Director, Bureau of Water *Karl Mueldener* Policy Memorandum #91-1
February, 1991

SUBJECT: Determination of the Types of Wastes
Eligible for Disposal into Class I
Underground Injection Control (UIC) Disposal Wells

PURPOSE:

To state the Bureau of Water policy for determining the types of wastes, excluding oil field brines regulated by the Kansas Corporation Commission, that are eligible for disposal through the use of Class I UIC disposal wells. The Bureau's objective is to protect against contamination of water and soil resources by ensuring compatibility of the injected waste with the well components, injection and confining zones and to use subsurface formations only for the disposal of those wastes that can not feasibly be treated, stored or disposed by other methods.

BACKGROUND:

The Bureau of Water administers the Class I UIC program developed pursuant to K.S.A. 65-171d. A major function of the program is to ensure the injection of waste is done in a controlled manner that will: 1) protect the soils and waters of the state from contamination, 2) protect human health, 3) conserve the water resources of the state, 4) encourage alternatives to the injection of wastes, and 5) use subsurface formations only for the disposal of those wastes that can not feasibly be treated, stored or disposed by other methods.

POLICY:

The use of Class I UIC disposal wells will be considered only for those wastes that cannot feasibly be treated, stored or disposed by other methods. Therefore, each new application for the disposal of wastes shall be accompanied by a report detailing the results of studies of alternate methods of waste treatment, storage or disposal technologies including an economic analysis based on a 30 year time period, justifying why subsurface disposal is considered the most feasible method of disposal.

In the even the applicant receives a Class I UIC permit, the permittee will be expected to develop, periodically update, and implement an ongoing waste minimization program which addresses the wastes being directed to the Class I UIC disposal well(s).

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The applicant will be required to use the most secure compatible disposal formation available. This will typically be one of the deeper formations such as the Arbuckle.

EFFECTIVE DATE:

The above policy will be in effect on February 1, 1991, and will remain in effect until withdrawn, revised, or modified by the Director.

bd



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KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

PROCEDURE FOR COMPLETING SECTION #10 OF THE PERMIT APPLICATION FOR A CLASS I NON-HAZARDOUS WASTE INJECTION WELL

Procedure #: UICI-14

Narrative:

The purpose of Section #10 of the application is to generate the geologic and geohydrologic information demonstrating the site of the proposed injection well has the characteristics suitable for the injection of wastes, including information demonstrating the wastes will be contained in the injection zone and the injection of wastes is not detrimental to the fresh and usable waters, the soils, or mineral production activities.

Procedure:

- ! As part of the information generated for Section #10, each of the following characteristics for a suitable injection site must be discussed, including an explanation as to whether or not the site has the necessary characteristics.
1. Injection interval sufficiently thick, with adequate porosity and permeability to accept waste at the proposed injection rate without necessitating excessive injection pressures.
 2. Injection interval of large enough areal extent so that injection pressure is minimized and so that injection waste will not reach discharge areas.
 3. Injection interval preferably "homogeneous" (without high-permeability lense or streaks), to prevent extensive fingering of the waste-vs-formation water contact, which would make adequate monitoring or prediction of waste movement extremely difficult or impossible.
 4. Overlying and underlying strata (confining beds) sufficiently thick and impermeable, to confine waste to the injection interval.
 5. Structural geologic conditions generally simple, that is a site reasonably free of complex faulting and folding.
 6. Site is an area of minor to moderate earthquake damage and low seismic activity so that the hazard of earthquake damage or triggering of seismic events is minimized.
 7. Slow lateral movement of fluid in the injection interval, under natural conditions, to prevent rapid movement of waste away from the injection site, possibly to a discharge area.

(Over)

8. Formation-fluid pressure normal to low so that excessive fluid pressure is not needed for injection.
9. Formation temperature normal to low so that the rates of undesirable reactions are minimized, including corrosion.
10. Wastewater compatible with formation fluids and minerals or can be made compatible by treatment, emplacement of a buffer zone or other means.
11. Formation water in the disposal formation of no apparent value, i.e. not potable, unfit for industrial or agricultural use, and not containing minerals in economically recoverable quantities.
12. Injection interval adequate separated from fresh and usable water zones, both horizontally and vertically.
13. Waste injection does not endanger present or future use of mineral resources (coal, oil, gas, brine, others).
14. Waste injection does not affect existing or planned gas-storage or freshwater-storage projects.
15. No unplugged or improperly abandoned wells penetrating the disposal formation in the vicinity of the disposal site, which could lead to contamination of other resources.

! The geology and geohydrology should first be evaluated on a regional basis and then examined at the local level in more detail. Maps and cross-sections available in the literature are acceptable for the regional evaluation. The evaluation on the local level requires constructing maps and cross-sections using information from available well control in the area. The area may encompass several townships around the injection well.

! The location of the injection well must be shown on cross-sections and maps.

! All maps and cross-sections must be clearly labelled and have a legend if appropriate.

! A reference must be provided for any equations used. All values and a reference for any values used in any equation must be provided.

! All information or conclusions taken from available literature must be referenced.

! Interpretations of all maps, cross-sections, and geohydrologic information must be provided. Describe what the information indicates and the significance in relation to the injection and containment of waste fluids.

! The depositional, structural and seismic history must be discussed in detail including the significance in relation to the injection and containment of waste.

- ! The predicted temperature of the injection zone can be calculated if there is no actual temperature information available from wells in the area.
- ! Considerable effort must be made to determine porosity and permeability of significant geologic units penetrated by the injection well, especially confining units and aquifers. This should be accomplished by evaluating wireline logs, core data, formation tests or other information for wells in the area. Always use any information available from the well itself. If these sources of information are not available, then literature values with appropriate references are acceptable.
- ! The concept of a confining zone is a zone consisting of multiple formations with alternating permeable and low permeability units or formations. The confining zone must also be significantly thick (>1000' in most cases). The top of the confining zone should be easily identifiable and mappable. The base of the confining zone is considered to be the top of the injection zone.
- ! In regards to the information required for all mineral owners that may be affected by the migration of waste over the life of the injection well, the one mile radius area of review is considered. If a mineral right is not leased or currently exploited, the landowners in most cases retains 100% ownership of the minerals and would still be impacted.
- ! The report on the results of a corrosion test on the injection well components can be satisfied by submittal of manufacturer's testing data demonstrating compatibility to a waste similar to what is proposed for injection. The data must be properly referenced and documented.
- ! In calculating injection zone pressure build-up, cone of influence, and predicted distance of wastewater flow from the injection well a common value used for the life of a well in these calculations is 20 years.



ARTIFICIAL PENETRATION REVIEW

Control #	_____	Status	_____
Operator	_____	Distance from Injector	_____
Lease	_____	Location	_____
Well #	_____		

PROVIDE WELL DIAGRAM:

POTENTIAL PROBLEM:



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KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

PROCEDURE FOR CONDUCTING A COMPATIBILITY EVALUATION FOR A CLASS I DISPOSAL WELL

Procedure #: UICI-10

Narrative:

The purpose of this document is to provide a listing of several common procedures for conducting a compatibility evaluation.

The well materials must be compatible with the wastes with which the material may be expected to come into contact. This is necessary to prevent failure of internal mechanical integrity. Failure of mechanical integrity is a serious threat to human health and the environment. Forms of corrosion for metal materials include uniform thinning, pitting, galvanic corrosion, dezincification, parting, cracking, erosion corrosion and crevice corrosion. Results of attack by the waste on plastic materials include swelling, cracking, blistering, softening and delamination.

The waste must also be compatible with the disposal formation, material and fluids and the confining strata material. Failure of the confining zone strata could allow injected wastes to escape from the disposal zone and threaten fresh or usable waters or the human health. Dissolution of limestone or dolomite disposal formation material could result in the development of cavities that may result in a structural stability problem. CO₂ gas development as a result of acidic waste reacting with limestone or dolomite can cause a well blowout forcing waste and formation fluids to the surface and also causing damage to the well components. Gases entrapped in pore spaces resulting from phase separation can reduce permeability. Incompatibility of the waste with disposal formation fluids or materials can result in plugging and reduced permeability limiting the capacity of the well to accept fluids or plugging the formation completely. Severe permeability damage or reduction may not be correctable and the use of well could be lost.

Generally speaking; with increasing temperature, pressure, gas content, or total dissolved solids; corrosivity and reactivity are increased.

Suspended solids, entrained gas and oil must be removed from the waste to the highest degree feasible prior to injection because these all have the potential to plug the disposal formation and reduce the capacity of the formation to accept fluid.

Procedure:

One type of compatibility evaluation is a comparison of the predicted conditions to known reactions. Listed are some of the common potential adverse reactions between various types of wastes and disposal formation materials and fluids that have been observed in the field and in the laboratory.

Waste and Formation Material Reactions

- !** Acidic waste will react with dolomite and limestone. The prevalent reaction is between the acid and CaCO₃ or Ca-Mg CO₃. This can result in the formation of CO₂ gas, potentially resulting in a blowout. A cavity in the formation can also develop causing a potential structural stability problem, weakening

of the formation and/or development of undesirable fractures through the disposal formation and/or confining strata.

- ! Under certain conditions gels can form when acidic waste reacts with CaCO_3 material resulting in mechanical plugging of the formation.
- ! Dissolution of CaCO_3 by acidic wastes can cause over saturation of the disposal formation with CO_2 and calcium salts, decreasing permeability.
- ! Acidic waste can dissolve clay minerals. The H^+ ion replaces the metal ions in the clay resulting in a breakdown of the clay structure and the release of particles that can plug pores.
- ! Acidic waste can react with sandstone causing iron to dissolve. Many sandstones have a large amount of iron in the cement between the sand grains. As the acid is neutralized the iron reprecipitates, plugging the pores and reducing permeabilities.
- ! Acidic waste can dissolve CaSO_4 cement in sandstone and subsequent reprecipitation can cause blocking of pores.
- ! Highly alkaline wastes can dissolve silica damaging the clay structure and releasing fine clay particles causing plugging.
- ! Waste with a low salt concentration may cause swelling or dispersion of clays resulting in reduced permeability. The cations are released from the clay and the vacant spaces then hydrate, causing swelling. Bentonite is very reactive with water and will swell to 10 times its unreactive size. Kaolinite is the least reactive of the clay minerals.
- ! Polar organic chemicals are readily absorbed onto clay and silicates and may cause a reduction in permeability. This reaction is more severe in sandstone than in carbonates.
- ! Phenols can cause swelling of clays resulting in a reduction in permeability.

Waste and Disposal Formation Fluid Reactions

- ! Certain pressure or temperature changes may cause gas to come out of solution forming a gas phase. Above their critical temperature, some gases can not be held in solution. This can result in plugging of pores reducing permeability.
- ! Reactions of alkaline earths and heavy metals with carbonates and bicarbonates are caused by changes in the equilibrium between CO_2 , HCO_3^- and CO_3^{2-} . Such changes can result in the precipitation of the carbonate or bicarbonate of Ca, Mg, Fe, or Mn.
- ! Oxidation of H_2S by chromium can form a precipitate. Oxidation of ferrous iron by dissolved oxygen or changes in pH can cause the formation of insoluble ferrous hydroxide.
- ! Sulfate reducing bacteria in the formation can reduce sulfate and sulfur to insoluble sulfides and sulfur.
- ! The growth of iron bacteria or other type of bacteria can clog the borehole face.
- ! Other common precipitations are 1) alkaline metals such as Ba, Ca and Sr typically as carbonate, sulfates, 2) metals such as Al, Cd, Cr, Fe, Mn, Ni, Zn, As, Hg, Pb as carbonates, hydroxides, or sulfides, 3) organics through polymerization. These can all cause plugging of the disposal formation.

- ! Dissolved iron and H₂S can result in precipitation of sulfides.
- ! Above a pH of 10; Ca, Ba, Sr, Mg and Fe can all form gelatinous hydroxide precipitates.

Other evaluations of compatibility between the waste and disposal formation material and fluids and can consist of one or more of the following procedures:

- ! Batch tests in which various percentages of the waste are mixed in a series of reactors with either actual or simulated formation waters. The solutions are then allowed to react. The reactors are opened in sequence at regular time intervals and the fluids analyzed and evaluated for the type and amount of precipitate formed, gas evolution and other reactions. The test should be conducted under reservoir temperature and pressure conditions.
- ! Batch tests in which waste is mixed with disaggregated formation samples or formation cores to determine gas evolution and other waste/disposal zone mineral reactions. The test should be conducted under reservoir temperature and pressure conditions. The wastes and formation materials are mixed in the same proportion as expected in the field. The reactors are opened in sequence at regular time intervals and the fluid analyzed.
- ! Dynamic Coreflood Tests use undisturbed cores or packed columns. The same core is used throughout the experiment and the outflow end is monitored at specified intervals to observe changes in chemistry. If precipitation-dissolution reactions occur, pressure changes caused by clogging or increased permeability can be monitored. The test should be conducted under reservoir temperature and pressure conditions. The dynamic coreflood test yields the most representative data.
- ! Chemical equilibrium models can be used to predict theoretical activities of aqueous species and to calculate the saturation indices for selected minerals.
- ! The saturation or stability index can be used as a means to anticipate instability in a system affected by more than one variable. A common index is the Stiff and Davis (1952) which is intended for use with concentrated solutions. The index is used to determine if a precipitate will form or if the fluid is corrosive.

Evaluations of compatibility between the waste and well components can include the following:

- ! To test compatibility between the waste and metal well components, the use of coupons of material identical to those used in construction of the well are placed in contact with the waste under pressure and temperature conditions expected at the wellhead. The material is then checked for loss of mass and thickness. The coupon is also visually observed for pitting, cracking, or other signs of corrosion. For compatibility with plastic type material the material is observed for swelling, cracking, blistering, softening, delamination or other signs of attack on the material.
- ! The saturation or stability index can be used as a means to anticipate instability in a system affected by more than one variable. A common index is the Stiff and Davis (1952) which is intended for use with concentrated solutions. The index is used to obtain if the fluid is corrosive.

Summary

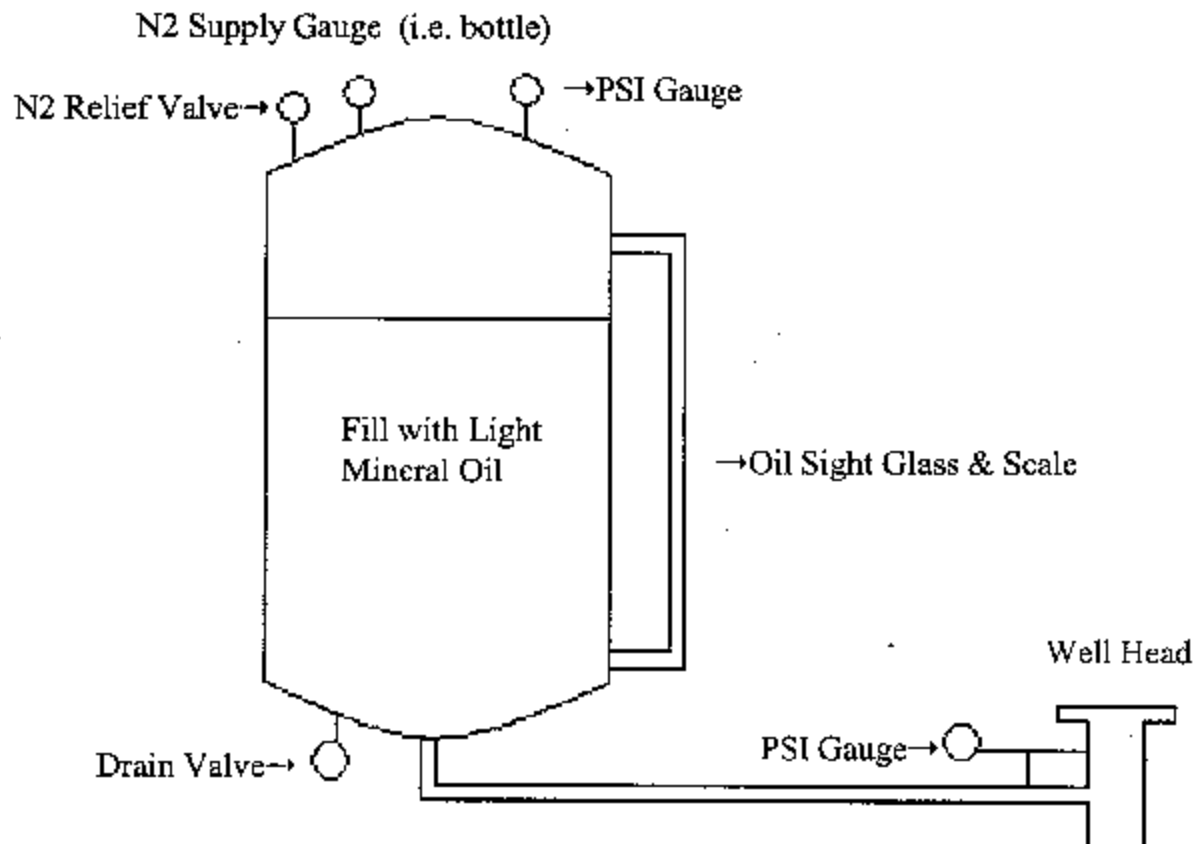
This procedure document describes several methods for conducting a compatibility evaluation. Each disposal project is unique and has its own degree of complexity. The study should be as detailed and as site specific as feasible. The evaluation must be suited to the physical and chemical characteristics of the waste and the geology, geochemistry, and

operational conditions of the proposed project. If available, actual fluids and materials should be used for actual testing. A proper compatibility evaluation will require the use of experienced and qualified professionals who have access to the necessary testing equipment and are knowledgeable of proper testing procedures.

REFERENCES

- ! Evaluation of Underground Injection of Industrial Waste in Illinois, 1989, Brower & Visocky
- ! Assessing the Geochemical Fate of Deep-Well Injected Hazardous Waste-A Reference Guide, 1990, EPA
- ! Assessing the Geochemical Fate of Deep-Well Injected Hazardous Waste-Summaries of Recent Research, 1990, EPA
- ! Injection of Hazardous Waste Into Deep Wells State-Of-The-Art Report, 1987, Strycher & Collins
- ! Subsurface Wastewater Injection, 1977, Warner & Lehr
- ! Underground Waste Management, 1973, American Association of Petroleum Geologists Second International Symposium on Underground Waste Management and Artificial Recharge
- ! Management of Hazardous Wastes by Deep-Well Disposal, 1987, Environmental Institute for Waste Management Studies, Open File Report #11

TYPICAL ANNULUS SEAL POT





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KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

PROCEDURE FOR DEMONSTRATING FINANCIAL ASSURANCE FOR A CLASS I INDUSTRIAL WASTE DISPOSAL WELL

Procedure #: UICI-8

Narrative:

The owner or operator of a Class I industrial waste disposal well is required to establish and maintain financial responsibility and resources to plug and abandon the well. The Owner or operator shall show such evidence of financial responsibility by the submission to KDHE one of the financial assurance mechanisms described in the procedure section of this document. K.A.R. 28-46-9, 28-46-31 and the Underground Injection Control permit establish the requirement for financial assurance.

Procedure:

This section provides the requirements for four different mechanisms for providing financial assurance. These mechanisms are the financial guarantee bond, performance bond, irrevocable standby letter of credit and financial test. All but the financial test also requires the establishment of a standby trust. The format for each type of bond, irrevocable standby letter of credit, the financial test and the standby trust are attached.

Financial Guarantee Bond

The owner or operator may satisfy the requirement of this mechanism by submitting a Financial Guarantee Bond and standby trust agreement. In addition the following apply:

1. The surety company issuing the bond must, at a minimum, be among those listed as acceptable sureties on Federal bonds in Circular 570 of the U.S. Department of Treasury. Documentation this requirement is satisfied must be submitted.
2. The wording of the bond must be identical to the wording specified in the attached Financial Guarantee Bond format.
3. A standby trust fund must also be established. An originally signed duplicate of the standby trust agreement shall be submitted to KDHE with the financial guarantee bond. The wording of the standby trust agreement must be identical to the wording specified in the attached standby trust agreement format
4. The penal sum of the bond shall be in an amount at least equal to the highest of three current plugging and abandonment cost estimates. To document the penal sum determined, the three written cost estimates, in current dollars, of the cost of plugging and abandonment of the well in accordance with the KDHE approved plugging and abandonment plan shall be submitted.

A list of items to be considered when developing the plugging the abandonment cost estimate is attached. **In addition, the Owner or operator shall annually submit three updated plugging and abandonment cost estimates, based on the currently KDHE approved plugging and abandonment plan, to account for inflation.** Whenever the current plugging and abandonment cost estimate increases to an amount greater than the penal sum, the owner or operator, within 60 days after the increase, shall either submit a modification to the bond increasing the penal sum to an amount at least equal to the highest of the three current plugging and abandonment cost estimates or obtain and submit other financial assurance approved by KDHE.

Performance Bond

The owner or operator may satisfy the requirement of this mechanism by submitting a Performance Bond and standby trust agreement. In addition the following apply:

1. The surety company issuing the bond must, at a minimum, be among those listed as acceptable sureties on Federal bonds in Circular 570 of the U.S. Department of Treasury. Documentation this requirement is satisfied must be submitted.
2. The wording of the bond must be identical to the wording specified in the attached Performance Bond format.
3. A standby trust fund must also be established. An originally signed duplicate of the standby trust agreement shall be submitted to KDHE with the performance bond. The wording of the standby trust agreement must be identical to the wording specified in the attached standby trust agreement format.
4. The penal sum of the bond shall be in an amount at least equal to the highest of three current plugging and abandonment cost estimates. To document the penal sum determined, the three written cost estimates, in current dollars, of the cost of plugging and abandonment of the well in accordance with the KDHE approved plugging and abandonment plan shall be submitted.

A list of items to be considered when developing the plugging the abandonment cost estimate is attached. **In addition, the Owner or operator shall annually submit three updated plugging and abandonment cost estimates, based on the currently KDHE approved plugging and abandonment plan, to account for inflation.** Whenever the current plugging and abandonment cost estimate increases to an amount greater than the penal sum, the owner or operator, within 60 days after the increase, shall either submit a modification to the bond increasing the penal sum to an amount at least equal to the highest of the three current plugging and abandonment cost estimates or obtain and submit other financial assurance approved by KDHE.

Irrevocable Letter of Credit

The owner or operator may satisfy the requirement of this mechanism by submitting an Irrevocable Letter of Credit and standby trust agreement. In addition the following apply:

1. The issuing institution shall be an entity which has the authority to issue letters of credit and whose letter of credit operations are regulated and examined by a Federal and State agency. Documentation this requirement is satisfied must be submitted.
2. The wording of the letter of credit must be identical to the wording specified in the attached Irrevocable Letter of Credit format.

3. A standby trust fund must also be established. An originally signed duplicate of the standby trust agreement shall be submitted to KDHE with the Irrevocable Letter of Credit. The wording of the standby trust agreement must be identical to the wording specified in the attached standby trust agreement format.
4. The letter of credit must be issued in an amount at least equal to the highest of three current plugging and abandonment cost estimates. To document the sum determined, the three written cost estimates, in current dollars, of the cost of plugging and abandonment of the well in accordance with the KDHE approved plugging and abandonment plan shall be submitted.

A list of items to be considered when developing the plugging and abandonment cost estimate is attached. **The owner or operator shall annually submit three updated plugging and abandonment cost estimates based on the currently KDHE approved plugging and abandonment plan, to account for inflation.** Whenever the current plugging and abandonment cost estimate increases to an amount greater than the amount of the credit, the owner or operator, within 60 days after the increase, shall either submit a modification to the letter of credit increasing the letter of credit to an amount at least equal the highest of the three current plugging and abandonment cost estimates or obtain and submit other financial assurance approved by KDHE.

5. The letter of credit shall be accompanied by a letter from the owner or operator referring to the letter of credit by number, issuing institution, the KDHE UIC permit number, name and address of the facility, and the amount of funds assured for the plugging and abandonment of the well by the letter of credit..

Financial Test

The owner or operator may satisfy the requirements of this mechanism by demonstrating that it passes a financial test as specified in this section. To pass this test the owner or operator must meet the criteria of either (I) or (II) listed below. In addition, the information required in (III) listed below must be submitted to KDHE to satisfy the requirements of this mechanism. An owner or operator that is a corporation and a subsidiary of the parent corporation may meet the financial test requirements by submitting from the parent corporation a corporate guarantee and for the parent corporation the information required for the financial test mechanism. The corporate guarantee form is attached. Definitions used are listed as follows:

Assets - means all existing and all probable future economic benefits obtained or controlled by a particular entity.

Current assets - means cash or other assets or resources commonly identified as those which are reasonably expected to be realized in cash or sold or consumed during the normal operating cycle of the business.

Independently audited - refers to an audit performed by an independent certified public accountant in accordance with generally accepted auditing standards.

Liabilities - means probable future sacrifices of economic benefits arising from present obligations to transfer assets or provide services to other entities in the future as a result of past transactions or events.

Net working capital - means current assets minus current liabilities.

Net worth - means total assets minus total liabilities and is equivalent to owner's equity.

Parent Corporation - means a corporation which directly owns at least 50 percent of the voting stock of the corporation which is the owner or operator; the latter corporation is deemed a subsidiary of the parent corporation.

Tangible net worth - means the tangible assets that remain after deducting liabilities; such assets would not include intangibles such as goodwill and rights to patents or royalties.

(I) The owner or operator must have:

- (a) Two of the following three ratios: A ratio of total liabilities to net worth less than 2.0; a ratio of the sum of net income plus depreciation, depletion, and amortization to total liabilities greater than 0.1; and a ratio of current assets to current liabilities greater than 1.5; and
- (b) Net working capital and tangible net worth each at least six times the sum of the current plugging and abandonment cost estimate; and
- (c) Tangible net worth of at least \$10 million; and
- (d) Assets in the United States amounting to at least 90 percent of his total assets or at least six times the sum of the current plugging and abandonment cost estimate, or

(II) The owner or operator must have:

- (a) A current rating of his most recent bond issuance of AAA, AA, A or BBB as issued by Standard of Poor's or Aaa, Aa, A or Baa as issued by Moody's; and
- (b) Tangible net worth at least six times the sum of the current plugging and abandonment cost estimate; and
- (c) Tangible net worth of at least \$10 million; and
- (d) Assets located in the United States amounting to at least 90 percent of his total assets or at least six times the sum of the current plugging and abandonment cost estimates.

III. To demonstrate the financial test requirements are met, the owner or operator must submit the following:

- 1. A letter signed by the owner's or operator's chief financial officer and worded as specified in the attached letter from chief financial officer format.
- 2. A copy of the independent certified public accountant's report on examination of the owner's or operator's financial statements for the latest completed fiscal year; and
- 3. A special report from the owner or operator's independent certified public accountant to the owner or operator stating that

- a. It has compared the data which the letter from the chief financial officer specifies as having been derived from the independently audited year-fiscal year with the amounts in such financial statements and in connection with that procedure, no matters came to his attention which caused him to believe that the specified data should be adjusted.
- b. In connection with that procedure, no matters came to his attention which caused him to believe that the specified data should be adjusted.

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Procedure: UICI-8

01/00

Letter From Chief Financial Officer

[Address to Secretary of Kansas Department of Health and Environment (KDHE)].

I am the chief financial officer of [name and address of firm.] This letter is in support of this firm's use of the financial test to demonstrate financial assurance, as specified by KDHE.

[Fill out the following four paragraphs regarding injection wells and associated cost estimates. If your firm has no injection wells that belong in a particular paragraph, write "None" in the space indicated. For each injection well, include its KDHE Underground Injection Control (UIC) permit number or other appropriate Identification Number, name, address and current plugging and abandonment cost estimate.]

1. This firm is the owner or operator of the following injection wells for which financial assurance for plugging and abandonment is demonstrated through the financial test. The current plugging and abandonment cost estimate covered by the test is shown for each injection well: _____.
2. This firm guarantees, through the corporate guarantee, the plugging and abandonment of the following injection wells owned or operated by subsidiaries of this firm. The current cost estimate for plugging and abandonment so guaranteed is shown for each injection well: _____.
3. In other states, this firm, as owner or operator or guarantor, is demonstrating financial assurance for the plugging and abandonment of the following injection wells through the use of a test equivalent or substantially equivalent to the financial test specified by KDHE or the Environmental Protection Agency. The current plugging and abandonment cost estimate covered by such test is shown for each injection well: _____.
4. This firm is the owner or operator of the following injection wells for which financial assurance for plugging and abandonment is not demonstrated either to EPA or a State through the financial test or any other financial assurance mechanism or equivalent or substantially equivalent State mechanisms. The current plugging and abandonment cost estimate not covered by such financial assurance is shown for each injection well: _____.

This firm [insert "is required" or "is not required"] to file a Form 10K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

The fiscal year of this firm ends on [month, day]. The figures for the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed fiscal year, ended [date].

[Fill in Alternative I if the criteria of Section (I) of the KDHE guidance is used. Fill in Alternative II if the criteria of Section (II) of the KDHE guidance is used.]

Alternative I

1. (a) Current plugging and abandonment cost \$_____
- (b) Sum of the company's financial responsibility under
40 CFR Parts 264 and 265, Subpart H, currently met
using the financial test or corporate guarantee _____
- (c) Sum of any other financial responsibilities met using the financial
test or corporate guarantee (list the responsibilities) _____
- (d) Total of lines a, b and c _____
- *2. Total liabilities [if any portion of the plugging and
abandonment cost is included in total liabilities, you
may deduct the amount of that portion from this line and
add that amount to lines 3 and 4 _____
- *3. Tangible net worth _____
- *4. Net worth _____
- *5. Current assets _____
- *6. Current liabilities _____
- *7. Net working capital [line 5 minus line 6] _____
- *8. The sum of net income plus depreciation,
depletion and amortization _____
- *9. Total assets in U.S. (required only if less than 90%
of firm's assets are located in U.S.) _____

Yes or No

10. Is line 3 at least \$10 million? _____
11. Is line 3 at least 6 times line 1(d)? _____
12. Is line 7 at least 6 times line 1(d)? _____
- *13. Are at least 90% of firm's assets located in the U.S.? If not, complete line 14. _____
14. Is line 9 at least 6 times line 1(d)? _____
15. Is line 2 divided by line 4 less than 2.0? _____
16. Is line 8 divided by line 2 greater than 0.1? _____
17. Is line 5 divided by line 6 greater than 1.5? _____

Alternative II

1. (a) Current plugging and abandonment cost \$_____
- (b) Sum of company's financial responsibilities under
40 CFR Part 264 and 265, Subpart H, currently met
using the financial test or corporate guarantee _____
- (c) Sum of any other financial responsibilities met using the financial
test or corporate guarantee (list the responsibilities) _____
- (d) Total of lines a, b and c _____
2. Current bond rating of most recent issuance of this firm
and name of rating service _____
3. Date of issuance of bond _____
4. Date of maturity of bond _____
- *5. Tangible net worth [if any portion of the plugging and abandonment
cost estimate is included in "total liabilities" on your firm's
financial statements, you may add the amount of that portion to
this line] _____
- *6. Total assets in U.S. (required only if less than 90% of firm's
assets are located in U.S.) _____

Yes or No

7. Is line 5 at least \$10 million? _____
8. Is line 5 at least 6 times line 1(d)? _____
- *9. Are at least 90% of the firm's assets located in the U.S.? If
not, complete line 10 _____
10. Is line 6 at least 6 times line 1(d)? _____

[Signature]

[Name]

[Title]

[Date]

Guarantee for Plugging and Abandonment

Guarantee made this ____ day of _____, 19____, by [name of guaranteeing entity], a business corporation organized under the laws of the State of _____, herein referred to as guarantor, to the Kansas Department of Health and Environment (KDHE), obligee, on behalf of our subsidiary [owner or operator] of [business address].

Recitals

1. Guarantor meets or exceeds the financial test criteria and agrees to comply with the reporting requirements for guarantors as specified by KDHE.
2. [Owner or operator] owns or operates the following Class I waste injection well covered by this guarantee: [List for each facility: KDHE permit Number, name and address. Indicate for each whether guarantee is foreclosure, post-closure case, or both.]
3. "Plugging and abandonment plan" as used below refers to the plans maintained as required by K.A.R. 28-46-34 and the KDHE issued underground injection control permit for the plugging and abandonment of injection wells as identified above.
4. For value received from [owner or operator], guarantor guarantees to KDHE that in the event that [owner or operator] fails to perform ["plugging and abandonment"] of the above facility(ies) in accordance with the plugging and abandonment plan and other requirements when required to do so, the guarantor will do so or fund a trust fund as specified by KDHE in the name of [owner or operator] in the amount of the adjusted plugging and abandonment cost estimates prepared as specified by KDHE.
5. Guarantor agrees that, if at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor will send within 90 days, by certified mail, notice to the Secretary of KDHE and to [owner or operator] that he intends to provide alternate financial assurance as specified by KDHE in the name of [owner or operator]. Within 30 days after sending such notice, the guarantor will establish such financial assurance if [owner or operator] has not done so.
6. The guarantor agrees to notify the Secretary of KDHE, by certified mail, of a voluntary or involuntary case under Title 11, U.S.Code, naming guarantor as debtor, within 10 days after its commencement.
7. Guarantor agrees that within 30 days after being notified by KDHE of a determination that guarantor no longer meets the financial test criteria or that he is disallowed from continuing as a guarantor of plugging and abandonment, he will establish alternate financial assurance, as specified by KDHE, in the name of [owner or operator] if [owner or operator] has not done so.
8. Guarantor agrees to remain bound under this guarantee notwithstanding any or all of the following: amendment or modification of the plugging and abandonment plan, the extension or reduction of the time of performance of plugging and abandonment or any other modification or alteration of an obligation of [owner or operator] pursuant to K.A.R. 28-46-9, K.A.R. 28-46-34 or the KDHE issued underground injection control permit.

with the applicable financial assurance requirements of KDHE for the above-listed facilities, except that guarantor may cancel this guarantee by sending notice by certified mail, to the Secretary of KDHE and to [owner or operator], such cancellation to become effective no earlier than 120 days after actual receipt of such notice by both KDHE and [owner or operator] as evidenced by the return receipts.

10. Guarantor agrees that if [owner or operator] fails to provide alternate financial assurance and obtain written approval of such assurance from the Secretary of KDHE within 90 days after a notice of cancellation by the guarantor is received by both the Secretary of KDHE and [owner or operator], guarantor will provide alternate financial assurance as specified by KDHE in the name of [owner or operator].
11. Guarantor expressly waives notice of acceptance of this guarantee by KDHE or by [owner or operator]. Guarantor also expressly waives notice of amendments or modifications of the plugging and abandonment plan.

Effective date: _____.

[Name of guarantor]

[Authorized signature for guarantor]

[Type name of person signing]

[Title of person signing]

Signature of witness or notary: _____

Irrevocable Standby Letter of Credit

Secretary
Kansas Department of Health and Environment
Building 283
Forbes Field
Topeka, Kansas 66620

Dear Sir or Madam:

We hereby establish our Irrevocable Standby Letter of Credit No. ____ in your favor, at the request and for the account of [owner's or operator's name and address] up to the aggregate amount of [in words] U.S. dollars \$_____, available upon presentation of:

- (1) Your sight draft, bearing reference to this letter of credit No. ____, and
- (2) Your signed statement reading as follows: "I certify that the amount of the draft is payable pursuant to regulations issued under authority of the Safe Drinking Water Act."

This letter of credit is effective as of [date] and shall expire on [date at least 1 year later], but such expiration date shall be automatically extended for a period of [at least 1 year] on [date] and on such successive expiration date, unless, at least 120 days before the current expiration date, we notify both you and [owner's or operator's name] by certified mail that we have decided not to extend this letter of credit beyond the current expiration date. In the event you are so notified, any unused portion of the credit shall be available upon presentation of your sight draft for 120 days after the date of receipt by both you and [owner's or operator's name], as shown on the signed return receipts.

Whenever this letter of credit is drawn on under and in compliance with the terms of this credit, we shall duly honor such draft upon presentation to us, and we shall deposit the amount of the draft directly into the standby trust fund of [owner's or operator's name] in accordance with your instructions.

We certify that the wording of this letter of credit is identical to the wording specified in 40 CFR 144.70(d) as such regulations were constituted on the date shown immediately below.

Signature and Title of Official of Issuing Institution

Date:

This credit is subject to [insert "the most recent edition of the Uniform Customs and Practice of Documentation Credits, published by the International Chamber of Commerce," or "the Uniform Commercial Code."].

**DEVELOPING A COST ESTIMATE
FOR PLUGGING OF A CLASS I
DISPOSAL WELL**

Labor for submitting detailed plan to KDHE

Pressure MIT

Pulling Unit

Gamma-Ray/Cement Bond Logs

Cement retainers and service personnel

Casing scraper rental

Workstring rental

Cement for possible casing squeeze

Cement to plug open hole and casing

Trucking

Water truck

Welder for welding metal cap

Surveyor and report

Supervision to complete plugging and writing of final report

Miscellaneous fittings and connections

FINANCIAL GUARANTEE BOND

Date bond executed: _____

Effective date: _____

Principal: [legal name and business address of owner or operator].

Type of organization: [insert "individual", "joint venture", "partnership", or "corporation"].

State of incorporation: _____

Surety(ies): [name(s) and business address(es)].

KDHE UIC Permit Number, name, address, and plugging and abandonment amounts for each injection well guaranteed by this bond [indicate plugging and abandonment amounts for each well]:

Total penal sum of bond: \$_____

Surety's bond number: _____

Know All Persons By These Presents, That We, the Principal and Surety(ies) hereto are firmly bound to the Kansas Department of Health and Environment (hereinafter called KDHE), in the above penal sum for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns jointly and severally; provided that, where the Surety(ies) are corporations acting as co-sureties, we, the Sureties, bind ourselves in such sum "jointly and severally" only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety, but if no limit of liability is indicated, the limit of liability shall be the full amount of the penal sum.

Whereas said Principal is required, under the Underground Injection Control Regulations (UIC), to have a permit in order to own or operate such injection well identified above, and

Whereas said Principal is required to provide financial assurance for plugging and abandonment as a condition of the permit, and

Whereas said Principal shall establish a standby trust fund as is required when a surety bond is used to provide such financial assurance;

Now, Therefore, the conditions of this obligation are such that if the Principal shall faithfully, before the beginning of plugging and abandonment of each injection well identified above, fund the standby trust fund in the amount(s) identified above for the injection well,

Or, if the Principal shall fund the standby trust fund in such amount(s) within 15 days after an order to begin plugging and abandonment is issued by the Secretary of KDHE or a U.S. district court or other court of competent jurisdiction,

Or, if the Principal shall provide alternate financial assurance, as specified by KDHE, and obtain the Secretary of KDHE's written approval of such assurance, within 90 days after the date of notice of cancellation is received by both the Principal and the Secretary of KDHE from the Surety(ies), then this obligation shall be null and void, otherwise it is to remain in full force and effect.

The Surety(ies) shall become liable on this bond obligation only when the Principal has failed to fulfill the conditions described above. Upon notification by the Secretary of KDHE that the Principal has failed to perform as guaranteed by this bond, the Surety(ies) shall place funds in the amount guaranteed for the injection well(s) into the standby trust funds as directed by the Secretary of KDHE.

The liability of the Surety(ies) shall not be discharged by any payment or succession of payments hereunder, unless and until such payment or payments shall amount in the aggregate to the penal sum of the bond, but in no event shall the obligation of the Surety(ies) hereunder exceed the amount of said penal sum.

The Surety(ies) may cancel the bond by sending notice by certified mail to the owner or Principal and to the Secretary of KDHE, provided, however, that cancellation shall not occur during the 120 days beginning on the date of receipt of the notice of cancellation by both the Principal and the Secretary of KDHE, as evidenced by the return receipts.

The Principal may terminate this bond by sending written notice to the Surety(ies), provided, however, that no such notice shall become effective until the Surety(ies) receive(s) written authorization for termination of the bond by the Secretary of KDHE.

In Witness Whereof, The Principal and Surety(ies) have executed this Financial Guarantee Bond and have affixed their seals on the date set forth above.

The persons whose signatures appear below hereby certify that they are authorized to execute this surety bond on behalf of the Principal and Surety(ies).

Principal

[Signature(s)]

[Name(s)]

[Title(s)]

[Corporate seal]

Corporate Surety(ies)

[Name and address]

State of incorporation: _____

Liability limit : \$_____

[Signature(s)]

[Name(s) and title(s)]

[Corporate seal]

[For every co-surety, provide signature(s), corporate seal, and other information in the same manner as for Surety above.]

Bond premium: \$_____

STANDBY TRUST AGREEMENT

Kansas Department of Health and Environment
Underground Injection Control (UIC)
Financial Responsibility Requirement

TRUST AGREEMENT, the "Agreement," entered into as of [date] by and between [name of the owner or operator], a [name of State] [insert "corporation," "partnership," "association," or "proprietorship"], the "Grantor," and [name of corporate trustee], [insert "incorporated in the State of _____" or "a national bank"], the "Trustee".

Whereas, the Kansas Department of Health and Environment, "KDHE", an agency of the State of Kansas, has established certain regulations applicable to the Grantor, requiring that an owner or operator of an injection well shall provide assurance that funds will be available when needed for plugging and abandonment of the injection well, and

Whereas, the Grantor has elected to obtain [insert "a surety bond", "performance bond" or "a letter of credit"] and establish a standby trust to provide all or part of such financial assurance for the facility(ies) identified herein, and

Whereas, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the trustee under this agreement, and the Trustee is willing to act as trustee,

Now, therefore, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement:

- (a) The term "Grantor" means the owner or operator who enters into this Agreement and any successors or assigns of the Grantor.
- (b) The term "Trustee" means the Trustee who enters into this Agreement and any successor Trustee.
- (c) "Facility" or "activity" means any underground injection well or any other facility or activity that is subject to regulation under the Underground Injection Control Program.

Section 2. Identification of Facilities and Cost Estimates. This agreement pertains to the facilities and cost estimates identified on attached Schedule A [on Schedule A, for each facility list the KDHE UIC Permit Number, name, address, and the current plugging and abandonment cost estimate, or portions thereof, for which financial assurance is demonstrated by this Agreement].

Section 3. Establishment of Fund. The Grantor and the Trustee hereby establish a trust fund, the "Fund", for the benefit of KDHE. The Grantor and the Trustee intend that no third party have access to the Fund except as herein provided. The Fund is established initially as consisting of a total of \$ -0- which is acceptable to the Trustee. The property as described in Schedule B attached hereto and any other property subsequently transferred to the Trustee is referred to as the Fund, together with all earning and profits thereon, less any payments or distributions made by the Trustee pursuant to this Agreement. The Fund shall be held by the

Trustee, IN TRUST, as hereinafter provided. The Trustee shall not be responsible nor shall it undertake any responsibility for the amount or adequacy of, nor any duty to collect from the Grantor, any payments necessary to discharge any liabilities of the Grantor established by KDHE.

Section 4. Payment of Plugging and Abandonment. The Trustee shall make payments from the Fund as the Secretary of KDHE shall direct, in writing, to provide for the payment of the costs of plugging and abandonment of the injection wells covered by this Agreement. The Trustee shall reimburse the Grantor or other persons as specified by the Secretary of KDHE from the Fund for plugging and abandonment expenditures in such amounts as the Secretary of KDHE shall direct in writing. In addition, the Trustee shall refund to the Grantor such amounts as the Secretary of KDHE specifies in writing. Upon receipt, such funds shall no longer constitute part of the Fund as defined herein.

Section 5. Payments Comprising the Fund. Payments made to the Trustee for the Fund shall consist of cash or securities acceptable to the Trustee.

Section 6. Trustee Management. The Trustee shall invest and reinvest the principal and income of the Fund and keep the Fund invested as a single fund, without distinction between principal and income, in accordance with general investment policies and guidelines which the Grantor may communicate in writing to the Trustee from time to time, subject, however, to the provisions of this Section. In investing, reinvesting, exchanging, selling, and managing the Fund, the Trustee shall discharge his duties with respect to the trust fund solely in the interest of the beneficiary and with the care, skill, prudence, and diligence under the circumstances then prevailing, which person of prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and with like aims; except that:

- (i) Securities or other obligations of the Grantor, or any other owner or operator of the facilities, or any of their affiliates as defined in the Investment Company Act of 1940, as amended, 15 U.S.C. 80a-2.(a), shall not be acquired or held, unless they are securities or other obligations of the Federal or a State government;
- (ii) The Trustee is authorized to invest the Fund in time or demand deposits of the Trustee, to the extent insured by an agency of the Federal or State government; and
- (iii) The Trustee is authorized to hold cash awaiting investment or distribution uninvested for a reasonable time and without liability for the payment of interest thereon.

Section 7. Commingling and Investment. The Trustee is expressly authorized in its discretion:

- (a) To transfer from time to time any or all of the assets of the Fund to any common, commingled, or collective trust fund created by the Trustee in which the Fund is eligible to participate, subject to all of the provisions thereof, to be commingled with the assets of other trusts participating therein; and
- (b) To purchase shares in any investment company registered under the Investment Company Act of 1940, 15 U.S.C. 80a-1 et seq., including one which may be created, managed, underwritten, or to which investment advice is rendered or the share of which are sold by the Trustee. The Trustee may vote shares in its discretion.

Section 8. Express Powers of Trustee. Without in any way limiting the powers and discretions conferred upon the Trustee by the other provisions of this Agreement or by law, the Trustee is expressly authorized and empowered:

- (a) To sell, exchange, convey, transfer, or otherwise dispose of any property held by it, by public or private sale. No person dealing with the Trustee shall be bound to see to the application of the purchase money or to inquire into the validity or expediency of any such sale or other disposition;
- (b) To make, execute, acknowledge, and deliver any and all documents to transfer and conveyance and any and all other instruments that may be necessary or appropriate to carry out the powers herein granted;
- (c) To register any securities held in the Fund in its own name or in the name of a nominee and to hold any security in bearer form or in book entry, or to combine certificates representing such securities with certificates of the same issue held by the Trustee in other fiduciary capacities, or to deposit or arrange for the deposit of such securities in a qualified central depository even though, when so deposited, such securities may be merged and held in bulk in the name of the nominee of such depository with other securities deposited therein by another person, or to deposit or arrange for the deposit of any securities issued by the United States Government, or any agency or instrumentality thereof, with a Federal Reserve bank, but the books and records of the Trustee shall at all times show that all such securities are part of the Fund;
- (d) To deposit any cash in the Fund in interest-bearing accounts maintained or savings certificates issued by the Trustee, in its separate corporate capacity, or in any other banking institution affiliated with the Trustee, to the extent insured by an agency of the Federal or State government; and
- (e) To compromise or otherwise adjust all claims in favor of or against the Fund.

Section 9. Taxes and Expenses. All taxes of any kind that may be assessed or levied against or in respect of the Fund and all brokerage commissions incurred by the Fund shall be paid from the Fund. All other expenses incurred by the Trustee in connection with the administration of this trust, including fees for legal services rendered to the Trustee, the compensation of the Trustee to the extent not paid directly by the Grantor, and all other proper charges and disbursements to the Trustee shall be paid from the Fund.

Section 10. Annual Valuation. Commencing after initial funding of the trust, the Trustee shall annually, at least 30 days prior to the anniversary date of establishment of the Fund, furnish to the Grantor and to the Secretary of KDHE a statement confirming the value of the Trust. Any securities in the Fund shall be valued at market value as of no more than 60 days prior to the anniversary date of establishment of the Fund. The failure of the Grantor to object in writing to the Trustee within 90 days after the statement has been furnished to the Grantor and the Secretary of KDHE shall constitute a conclusively binding assent by the Grantor, barring the Grantor from asserting any claim or liability against the Trustee with respect to matters disclosed in the statement.

Section 11. Advise of Counsel. The Trustee may from time to time consult with counsel, who may be

counsel to the Grantor, with respect to any question arising as to the construction of this Agreement of any action to be taken hereunder. The Trustee shall be fully protected, to the extent permitted by law, in acting upon the advice of counsel.

Section 12. Trustee Compensation. The Trustee shall be entitled to reasonable compensation for its services as agreed upon in writing from time to time with the Grantor.

Section 13. Successor Trustee. The Trustee may resign or the Grantor may replace the Trustee, but such resignation or replacement shall not be effective until the Grantor has appointed a successor trustee and this successor accepts the appointment. The successor trustee shall have the same powers and duties as those conferred upon the Trustee hereunder. Upon the successor trustee's acceptance of the appointment, the Trustee shall assign, transfer, and pay over the successor trustee the funds and properties then constituting the Fund. If for any reason the Grantor cannot or does not act in the event of the resignation of the Trustee, the Trustee may apply to a court of competent jurisdiction for the appointment of a successor trustee or for instructions.

The successor trustee shall specify the date on which it assumes administration of the trust in a writing sent to the Grantor, the Secretary of KDHE, and the present Trustee by certified mail 10 days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this Section shall be paid as provided in Section 9.

Section 14. Instructions to the Trustee. All orders, requests, and instruction by the Grantor to the Trustee shall be in writing signed by such persons as are designated in the attached Exhibit A, or such other designees as the Grantor may designate by amendment to Exhibit A. The Trustee shall be fully protected in acting without inquiry in accordance with the Grantor's orders, requests, and instructions. All orders, requests, and instructions by the Secretary of KDHE to the Trustee shall be in writing, signed by the Secretary of KDHE or designee, and the Trustee shall act and shall be fully protected in acting in accordance with such orders, requests and instructions. The Trustee shall have the right to assume, in the absence of written notice to the contrary, that no event constituting a change or a termination of the authority of any person to act on behalf of the Grantor or KDHE hereunder has occurred. The Trustee shall have no duty to act in the absence of such orders, requests, and instructions from the Grantor and/or KDHE, except as provided for herein.

Section 15. Amendment of Agreement. This Agreement may be amended by an instrument in writing executed by the Grantor, the Trustee, and the Secretary of KDHE, or by the Trustee and the Secretary of KDHE if the Grantor ceases to exist.

Section 16. Irrevocability and Termination. Subject to the right of the parties to amend this Agreement as provided in Section 15, this Trust shall be irrevocable and shall continue until terminated at the written agreement of the Grantor, the Trustee, and the Secretary of KDHE or by the Trustee and the Secretary of KDHE if the Grantor ceases to exist. Upon termination of the Trust, all remaining trust property, less final trust administration expenses, shall be delivered to the Grantor.

Section 17. Immunity and Indemnification. The Trustee shall not incur personal liability of any nature in connection with any act or omission, made in good faith, in the administration of this Trust, or in carrying out any directions by the Grantor or the Secretary of KDHE issued in accordance with this Agreement. The

Trustee shall be indemnified and saved harmless by the Grantor or from the Trust Fund, or both, from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct in its official capacity, including all expenses reasonably incurred in its defense in the event the Grantor fails to provide such defense.

Section 18. Choice of Law. This Agreement shall be administered, construed, and enforced according to the laws of the State of [insert name of State].

Section 19. Interpretation. As used in this Agreement, words in the singular include the plural and words in the plural include the singular. The descriptive headings for each Section of this Agreement shall not affect the interpretation of the legal efficacy of this Agreement.

In Witness Whereof, the parties have caused this Agreement to be executed by their respective officers duly authorized and their corporate seals to be hereunto affixed and attested as of the date first above written.

By: _____
(Signature of Grantor)

(Title)

Attest: _____

(Title)

(SEAL)

By: _____
(Signature of Trustee)

(Title)

Attest: _____

(Title)

(SEAL)

- () This bank/institution has the authority to act as a trustee and its trust activities are examined and regulated by a State or Federal agency.

CERTIFICATE OF ACKNOWLEDGEMENT

FOR

STANDBY TRUST FUND AGREEMENT

STATE OF _____

COUNTY OF _____

On this _____ day of _____, 19_____, before me personally came

_____ to me known, who, being

by

(owner or operator)

me duly sworn, did depose and say that she/he resides at

(address)

that she/he is _____ of _____
(Title) (corporation)

_____, the corporation described in

and which executed the above instrument; that she/he knows the seal of said corporation; that the seal affixed to such instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that she/he signed her/his name thereto by like order.

(Notary Public)

(Seal)

SCHEDULE A

Identification of Facilities and Cost Estimates

Schedule A is referenced in the trust agreement dated _____ by and between:

_____, the "Grantor", and
(name of owner or operator)

_____, the "Trustee".
(name of trustee)

KDHE UIC Permit Number _____

Name of facility _____

Address of facility _____

Current plugging and
abandonment cost estimate _____

Date of estimate _____

KDHE UIC Permit Number _____

Name of facility _____

Address of facility _____

Current plugging and
abandonment cost estimate _____

Date of estimate _____

SCHEDULE B

Standby Letter of Credit

Schedule B is referenced in the trust agreement dated _____ by and between _____, the "Grantor" and _____, the "Trustee".

With reference to the current plugging and abandonment cost estimates of _____ detailed in SCHEDULE A, _____ issued Irrevocable Letter of Credit No. _____, valid from _____ until _____, with possible one-year extensions. This Letter of Credit was established for the amount of _____, and the beneficiary of SECRETARY OF THE KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT, 1000 SW Jackson Street, Topeka, Kansas 66612.

A copy of the above referenced Irrevocable Letter of Credit No. _____ is attached to this STANDBY TRUST AGREEMENT.

db

UIC Procedure Std-trus.agr

Schedule B
Performance Bond

Schedule B is referenced in the Standby Trust Agreement dated _____ by and between _____, the “Grantor”, and _____, the “Trustee”.

Funds drawn pursuant to the Performance Bond No. _____, whereby _____, as surety, guarantees the payment by _____, of up to _____ dollars (\$_____) for plugging and abandonment of the facilities described on Schedule A hereof dated as of _____ as said Performance Bond may be amended, supplemented or otherwise modified from time to time, and deposited in the fund _____ established herewith.

db

UIC Procedure schedule B

Schedule B

Financial Guarantee Bond

Schedule B is referenced in the Standby Trust Agreement dated _____ by and between _____, the “Grantor”, and _____, the “Trustee”.

Funds drawn pursuant to the Performance Bond No. _____, whereby _____, as surety, guarantees the payment by _____, of up to _____ dollars (\$_____) for plugging and abandonment of the facilities described on Schedule A hereof dated as of _____ as said Financial Guarantee Bond may be amended, supplemented or otherwise modified from time to time, and deposited in the fund established herewith.

db

UIC Procedure/fin guar bond/sch b



Reply to: (785) 296-5524 FAX (785) 296-5509
Bureau of Water - Geology Section
1000 S.W. Jackson, Ste. 420
Topeka, Kansas 66612-1367

KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

PROCEDURE FOR THE PLUGGING AND ABANDONMENT OF A CLASS 1 NON-HAZARDOUS WASTE DISPOSAL WELL-LONGSTRING CEMENTED FROM BOTTOM TO SURFACE

Procedure #: UICI-11

Narrative:

Prior to the plugging and abandonment of a Class I non-hazardous waste disposal well the owner/operator shall submit a revised plugging and abandonment plan to KDHE for review and approval. The well shall be plugged and abandoned in a manner which will prevent the movement of fluids. This is best accomplished by filling the well with cement from bottom to surface. The plan shall include both a prognosis and a diagram describing the well plugging. The plan shall include a description of cement mixtures (type, grade, additives), volume of cement to be used, and estimated compressive strength of the cement. Listed below is the procedure for plugging and abandonment which should be incorporated into the plugging plan. The plan shall include a proposed schedule for the plugging operation. In order to provide KDHE the opportunity to witness the plugging, the schedule for the work shall be mutually agreed upon. Plan approval shall be obtained from KDHE before commencing any plugging operation. Alternatives to this procedure which provide a comparable level of protection to the environment and human health will be considered by KDHE.

Procedure:

1. Conduct a pressure mechanical integrity test on the well. The pressure test shall be witnessed by KDHE and the test procedure must follow KDHE Procedure UICI-6 for pressure testing a Class I disposal well (copy attached). If leakage is indicated by the test, the location of the leakage must be identified, the impact to the environment evaluated and this information submitted to KDHE. Submittal of an environmental remediation plan and implementation schedule and/or a repair plan for the well may be required by KDHE for review and approval. No work shall commence until plan approval has been obtained from KDHE.
2. Remove the tubing and packer from the well.
3. Conduct a cement bond log and a gamma ray-neutron log on the well and any other tests or logs determined necessary by KDHE. Submit the logs and test results to KDHE for review and approval. Include an interpretation of the log and tests by a person with the technical expertise to evaluate the data.
4. Based on the evaluation of the logs and tests previously conducted on the well, complete any remedial work determined necessary by KDHE. A plan for remedial work must be submitted to KDHE for review and approval. No remedial work shall commence until plan approval has been obtained from KDHE.

5. Set a cement retainer at the base of the longstring casing just above the injection interval.
6. Displace cement through the retainer, squeezing the injection interval with cement.
7. After cementing the injection interval, close the bottom of the retainer and disconnect the cementing pipe from the top of the retainer.
8. Fill the casing with cement from the retainer to ground surface by pumping cement through the cementing tubing and slowly withdrawing the tubing from the well. Cement must circulate to surface.
9. Remove the cementing tubing from the well. Cement will fall back, therefore fill casing with cement back to surface.
10. Observe cement level in the casing after cement has set for 24 hours. If cement has fallen back, fill with cement back to surface.
11. Remove wellhead equipment.
12. Leave some casing above ground surface. Weld a metal cap on the casing inscribed with the Kansas UIC permit number and the date the well plugging was completed.
13. Submit a map showing the tri-coordinate location (includes elevation) of the remaining wellhead prepared by a licensed professional land surveyor or professional engineer licensed to practice in Kansas.
14. Submit a plugging report with related details to KDHE within 30 days of completing the plugging operation on a form provided by KDHE. Document the work done with appropriate service company cementing reports and "day" reports.

Attachment



Reply to: (785) 296-5524 FAX (785) 296-5509
Bureau of Water - Geology Section
1000 S. W. Jackson, Ste. 240
Topeka, KS 66612-1367

KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

PROCEDURE FOR CONDUCTING THE TEMPERATURE LOG FOR EVALUATING EXTERNAL MECHANICAL INTEGRITY OF A CLASS I WASTE DISPOSAL WELL

Procedure #: UICI-9

Narrative:

The purpose of this test is to evaluate the external mechanical integrity of the well. A well has external mechanical integrity if there is no fluid movement behind the casing through vertical channels adjacent to the wellbore. One method of checking external mechanical integrity is to conduct a series of temperature logs following the procedures listed in this document.

A plan for this test shall be submitted to KDHE for review and approval prior to conducting the test. In order to provide KDHE opportunity to witness the test, the schedule for conducting the test shall be mutually agreed upon. Plan approval shall be obtained from KDHE before commencing the test. The plan shall include a schematic of the well configuration for the test, a prognosis and a schedule for conducting the test. The procedure listed is general in nature. When developing a test procedure for an individual well; the well configuration, geology, hydrology, and operating conditions must be considered. K.A.R. 28-46-33 establishes mechanical integrity requirements.

Procedure:

1. Clear the wellbore of any material that would be corrosive to the logging tools and ensure that there are no obstructions that will prevent the passage of the temperature tool.
2. The temperature log must be conducted through the injection tubing to obtain "real condition" data and to be protective of human health and the environment.
3. An appropriate scale for the temperature log must be selected. Frequent shifts in the log will be required if the scale selected is too small which makes the log difficult to interpret. If the scale is too large, the log is again difficult to interpret because temperature changes and gradients are difficult to discern. A scale range of 4°F/inch to 10°F/inch is generally the best.
4. The temperature log shall be conducted in tandem with a collar locator log and a gamma-ray log. A differential temperature curve shall be included.
5. The temperature tool shall be sensitive to temperature changes of at least 0.1°F.
6. The temperature log shall be run going into the well. The logging speed should be between 20-35 feet per minute. The logging speed shall be kept constant for all sequential passes. Stopping the tool

during a log run should be avoided.

7. The well shall be shut-in for a minimum of 24 hours to allow the well to reach "static" conditions prior to running the base log.
8. Record the beginning and ending clock time on each log pass.
9. Run the base log from surface to total depth after the 24-hour shut-in period.
10. Record the temperature of the liquid to be injected just prior to injection and then periodically during injection, record the temperature of the liquid injected. Provide this information with the final report.
11. Inject the greater of either three well volumes or one barrel of fluid per each foot of disposal interval. The well volume is to be calculated using the volume of the longstring casing plus the open hole interval, if applicable. The best results are obtained when the difference between the injected fluid temperature and the wellbore temperature at the zone of interest is at least 35° F, especially if the temperature log is conducted through the tubing. In no case shall the temperature difference be less than 10°F. Even minor variations in the temperature of the injection water can adversely influence the results; thus, a source of water with a uniform temperature should be used. The injection rate used should be at a normal operational injection rate and, if feasible, the maximum permitted injection rate.
12. Cease injection and place the logging tool at a depth 300 feet above the disposal zone. Make three passes from 300 feet above the disposal zone to total depth at the one-hour, two-hour and the four-hour interval after stopping injection.
13. Pull the temperature log to surface. Run the final base temperature log from surface to total depth.
14. Submit the temperature logs to KDHE with the following information on each log:
 - a. time log was run
 - b. well conditions, shut-in, injecting
 - c. scales
 - d. logging speed
 - e. depth and size of various casings, depth and size of tubing, packer seat depth

A report shall accompany the logs describing the procedure, volume of fluid injected, well construction data, rate at which fluid was injected, and the injection pressure. The report shall also include an interpretation of the logs and a description of the temperature log results by a person with the technical expertise to evaluate the logs.

15. If the well is determined to be lacking external mechanical integrity, injection shall cease immediately and the permittee shall submit the following to KDHE for review and approval: 1) an evaluation of the impact to the environment which may require additional testing approved by KDHE, 2) an environmental remediation plan and implementation schedule, and 3) a repair plan and implementation schedule for the well. No work is to commence until plan and schedule approval has been obtained from KDHE.

**PARAMETERS FOR ANALYSES
OF
INJECTION INTERVAL FLUID SAMPLE**

Volatile Organic Compounds

(Method 624 - Purge & Trap GC/MS)

Detection limits nominally 10 ug/L

1. Benzene
2. Ethylbenzene
3. Toluene
4. Xylene

Heavy Metals

1. Antimony
2. Arsenic
3. Beryllium
4. Cadmium
5. Chromium
6. Copper
7. Lead
8. Mercury
9. Nickel
10. Selenium
11. Silver
12. Thallium
13. Zinc

Other Parameters

1. Total Hardness (CaCO₃)
2. Calcium
3. Sodium
4. Magnesium
5. Potassium
6. Total Alkalinity
7. Chloride
8. Sulfate
9. Fluoride
10. Nitrate
11. Iron
12. Manganese
13. Ammonia
14. Phosphate
15. Silica
16. Specific Conductance
17. Total Dissolved Solids
18. pH

*KDHE reserves the right to add any parameter as determined to be necessary



KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

PROCEDURE FOR CONDUCTING THE OXYGEN ACTIVATION (OA) LOG FOR EVALUATING EXTERNAL MECHANICAL INTEGRITY OF A CLASS I DISPOSAL WELL

Procedure #: UICI-3

Narrative:

The purpose of this test is to evaluate the external mechanical integrity of the well. A well has external mechanical integrity if there is no significant fluid movement behind the casing through vertical channels adjacent to the wellbore. One method of checking external mechanical integrity is by conducting the Oxygen Activation (OA) Log following the procedures listed in this document.

A plan for this test shall be submitted to KDHE for review and approval prior to conducting the test. In order to provide KDHE the opportunity to witness the test, the schedule for conducting the test shall be mutually agreed upon. Plan approval shall be obtained from KDHE before commencing the test. The plan shall include a prognosis and schedule for conducting the test. The procedure listed is general in nature. When developing a test plan for an individual well the well configuration, hydrogeology, and operating conditions must be considered. K.A.R. 28-46-33 establishes mechanical integrity requirements. Unlike other approved tests that are subject to interpretational opinion, the OA log provides a more direct method of determining external mechanical integrity.

Modification of this procedure will be considered providing it is demonstrated there is good cause and the objective of this procedure will be achieved.

Procedure:

1. Clear the wellbore of any material that would be corrosive to the logging tools and ensure that there are no obstructions in the well that will prevent passage of the tools.
2. Conduct a baseline Gamma Ray Log and casing collar locator log from the top of the injection zone to the surface prior to taking the stationary readings with the OA tool. This is necessary to evaluate the contribution of naturally occurring background radiation to the total gamma radiation count detected by the OA tool. There are different types of natural radiation emitted from various geologic formations or zones and the natural radiation may change over time.

3. The OA log shall be used only for casing diameters of greater than 1-11/16 inches and less than 13-3/8 inches.
4. All stationary readings should be taken with the well injecting fluid at the normal rate with minimal rate and pressure fluctuations.
5. Prior to taking the stationary readings, the OA tool must be properly calibrated in a "no vertical flow behind the casing" section of the well to ensure accurate, repeatable tool response and for measuring background counts.
6. Take, at a minimum, a 15 minute stationary reading adjacent to the confining interval located immediately above the injection interval. This must be at least 10 feet above the injection interval so that turbulence does not affect the readings.
7. Take, at a minimum, a 15 minute stationary reading at a location approximately midway between the base of the lowest most usable water zone and the confining interval located immediately above the injection interval.
8. Take, at a minimum, a 15 minute stationary reading adjacent to the top of the confining zone.
9. Take, at a minimum, a 15 minute stationary reading at the base of the lowermost usable water zone.
10. If flow is indicated by the OA log at a location, move uphole or downhole as necessary at no more than 50 foot intervals and take stationary readings to determine the area of fluid migration.
11. The results of the OA log and an interpretation of the log by a person with the technical expertise to evaluate the log shall be submitted to KDHE within 30 days of the test completion. Intervals where flow is indicated shall be described and the significance discussed.



KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

PROCEDURE FOR THE PRESSURE MECHANICAL INTEGRITY TEST FOR EVALUATING INTERNAL MECHANICAL INTEGRITY OF A CLASS I DISPOSAL WELL

Procedure #: UICI-6

Narrative:

The purpose of this test is to evaluate the internal mechanical integrity of the well. A well has internal mechanical integrity if there is no significant leak in the casing, tubing, or packer. Internal mechanical integrity is checked by conducting a hydraulic pressure test of the casing/tubing annulus and monitoring for a pressure loss. The test shall be witnessed by a representative of the KDHE, therefore the schedule for the test shall be mutually agreed upon.

A plan for this test shall be submitted to KDHE for review and approval prior to conducting the test. The plan shall include a prognosis and schedule for conducting the test. Include a diagram of the surface and subsurface well completion. The plan shall include a waste handling contingency plan to cope with the shut-in of the well that will be required should the well fail the test. Plan approval shall be obtained from KDHE before commencing the test. K.A.R. 28-46-33 establishes mechanical integrity requirements.

Procedure:

1. The test shall be a hydraulic test. The liquid pressure of the annulus is to be monitored for the purpose of determining integrity. It shall be demonstrated to the KDHE representative that the annulus is liquid filled. This can be demonstrated to the KDHE representative upon completion of the test.
2. The well must be in thermal equilibrium before commencing the test.
3. Once the annulus has been pressurized vent as much air as is feasible from the annulus. Repressure as necessary.
4. Once the annulus has been pressurized for the test the annulus shall be isolated from all external artificial sources capable of introducing pressure to the annulus.
5. The well shall be static during the test.
6. There shall be a demonstration by appropriate calculations or other information that the annulus hydrostatic pressure exceeds the tubing hydrostatic pressure and the formation pressure at all depths during the test.

7. The minimum surface annulus test pressure shall be 150 psi. Local geology, hydrology, or well design may necessitate the use of a higher test pressure.
8. A description of the pressure gauge to be used to monitor the test pressure must be provided. The gauge must have a scale such that the test pressure is 40-60% of full scale. The scale shall measure pressure in increments of no more than 2 psi per division. The gauge shall be tested for accuracy for the mechanical integrity test. A document with a description of the test, the test date, amount of error found on the gauge during the test and a description of corrective action such as recalibration shall be provided to the KDHE representative at the time of the mechanical integrity test. It shall be demonstrated that the gauge is functioning properly.
9. The test shall be a minimum one (1) hour in duration.
10. A pressure loss equal to or less than 5% of the initial test pressure is a satisfactory test and indicates the well has internal mechanical integrity at the time of the test. A pressure increase greater than 5% of the initial test pressure is not acceptable and may indicate the well has not reached thermal equilibrium.
11. The test shall be witnessed by a representative of KDHE. The test is valid only when witnessed by a representative of KDHE.
12. If a satisfactory test is not obtained the well shall remain out of service until corrective action has been taken and a satisfactory mechanical test conducted. The location of the leakage must be determined and the impact to the environment evaluated. An environmental remediation plan and/or a repair plan for the well may be required to be submitted to KDHE for review and approval. No work shall commence until plan approval has been obtained from KDHE.

Failure to follow the KDHE approved MIT plan may result in cancellation of the test and shut-in of the well until the MIT is rescheduled and conducted to the satisfaction of KDHE.



KANSAS DEPARTMENT OF HEALTH & ENVIRONMENT

FORMATION PRESSURE FALL-OFF TEST AND TESTING PLAN DEVELOPMENT PROCEDURES

Procedure #: UICI-2

SECTION I. PURPOSE

The purpose of this test is to identify injection interval or wellbore problems and injection interval characteristics. It is the responsibility of the permittee to develop a testing procedure which will generate adequate data for a meaningful analysis.

SECTION II. REGULATORY CITATION

KDHE regulation 28-46-30, which references 40 CFR (Code of Federal Regulations) 146.13 (d) and the UIC Permit require monitoring of the pressure buildup in the injection zone at least annually, including at a minimum, shut down of the well for a time sufficient to conduct a valid observation of the pressure fall-off. This test is known as the formation pressure fall-off test.

SECTION III. SCHEDULING OF TEST

The schedule for the test must be mutually agreed upon between KDHE and the permittee so that KDHE has the opportunity to witness the test.

SECTION IV. DEVELOPING A TEST PLAN

A plan for conducting the test shall be submitted to KDHE for review and approval prior to conducting the test. Plan approval shall be obtained from KDHE prior to commencing the test. The plan shall include a proposed schedule. The test plan must address all items listed in the Sections V through VIII of this document.

SECTION V. GENERAL PREPARATION

A review of previous fall-off tests should be conducted to assist in developing a testing procedure that will provide valid test results. This will help prevent repeating any previous mistakes or errors.

A successful test involves consideration of numerous factors of which most are under control of the permittee. These include but are not limited to the following:

1. Adequate storage for the injection liquid needs to be insured for the duration of the test.

2. Offset wells completed in the same formation as the test well should be shut-in prior to and during the test. If this cannot be accomplished then a low, constant injection rate into the offset injection wells should be maintained prior to and during the test, if feasible.
3. The condition of the well, junk in the hole, wellbore fill or wellbore damage (as measured by skin) may significantly increase the length of time the well must be shut-in to obtain valid fall-off test data. This is especially true for wells completed in low transmissivity reservoirs or which have large skin factors.
4. The location of the shut-in valve to cease flow to the well for the shut-in portion of the test must be located at or near the wellhead. Shut-in must be accomplished as instantaneously as possible to prevent erratic pressure behavior during the test.
5. In most cases the waste liquid can be used unless the waste will be corrosive to the downhole pressure gauge.
6. A surface readout downhole pressure gauge must be used. The capability to produce plots necessary to analyze the test data should be available at the well site to help insure valid test data is obtained and false test runs are quickly identified and aborted. The gauge should be configured to obtain pressure data more frequently in the early portion of the test when the rate of pressure decline is greater. Larger time increments may be used to obtain data later in the test when the rate of pressure decline is less.

SECTION VI. CONDUCTING THE FALL-OFF TEST

The following is the recommended procedure for conducting the test. Alternative procedures that will produce valid test results and which will satisfy the requirements of KDHE and the regulations will be considered by KDHE.

1. The depth to any fill in the well should be tagged and recorded.
2. The surface readout downhole pressure gauge must be located at or near the top of the injection interval. A surface readout should be provided to allow flexibility in determining appropriate pressure measuring and recording time intervals and to insure valid test data is generated and false testing runs can be identified and aborted.
3. The injection rate and injection liquid density for the test must be held constant prior

to shut-in. The injection rate must be high enough and continuous for a period of time sufficient to produce a pressure buildup that will result in valid test data. The injection rate must result in a pressure buildup such that a semilog straight line can be determined from the Horner plot. The injection rate should be the maximum injection rate that can be feasibly maintained constant in order to maximize pressure changes in the formation and provide valid test results, but not exceeding the daily injection volume limit of the UIC Permit.

4. The injection rate and the density (chloride concentration, total dissolved solids concentration, conductivity or pH are also acceptable) of the injection fluid must be periodically measured and recorded to insure these parameters remain constant.
5. If the stabilization injection period is interrupted, for any reason and for any length of time, the stabilization injection period must be restarted.
6. The well must be shut-in at the wellhead or as near to the wellhead as feasible in order to minimize wellbore storage and afterflow. The shut-in must be accomplished as instantaneously as possible to prevent erratic pressure behavior during the test.
7. The fall-off portion of the test must be conducted for a length of time sufficient such that the pressure is no longer influenced by wellbore storage or skin effects and enough data points lie within the infinite acting period and the semilog straight line is well developed.

SECTION VII. EVALUATION OF THE TEST RESULTS

The test results must be evaluated by a person knowledgeable in the methods of pressure transient test analysis.

The following information and evaluations must be provided with the test report:

1. A log-log plot with a derivative diagnostic plot must be used to identify flow regimes. The wellbore storage portion and infinite acting portion of the test must be identified on the plot. Type curves must be used to verify results.
2. A Horner plot must be used to calculate the kh/u product and to determine P^* . An expanded Horner plot containing the entire infinite acting portion must be reproduced in order to permit a closer inspection of the semilog slope and any data fluctuations. The slope used to calculate the kh/u product and to determine P^* must be drawn on both Horner plots. In addition, the wellbore storage portion and infinite acting portion of the test must be identified on both plots.

3. The "h" value (injection interval thickness) used must be agreed upon between KDHE and the permittee. For formations with characteristics such as the Arbuckle Formation, the injection interval should be considered the entire thickness of the injection formation in the area. A reliable literature value can be used if site specific data is not available.
4. The viscosity used in analyzing the test must be that of the liquid through which the pressure transient was propagating during the infinite acting portion of the test. The information used to determine the viscosity must be provided.
5. Any test that was not shut-in long enough to develop an infinite acting period, or cannot be properly analyzed for the kh/u group of parameters using the Horner method, should be rerun, using a procedure that will result in valid test results, unless other arrangements have been made with KDHE.
6. All equations used in the analysis must be provided with the appropriate parameters substituted in them.
7. Tests conducted in relatively transmissive reservoirs are more sensitive to the temperature compensation mechanism of the gauge, because the pressure buildup response evaluated is smaller. For this reason, the plot of the temperature data should be reviewed. Any temperature anomalies should be noted to determine if they correspond to pressure anomalies.
8. Explain any anomalous data responses. The analyst should investigate physical causes other than reservoir responses.

SECTION VIII. REPORT COMPONENTS

The report to KDHE must include general information and an overview of the test, present and analyze the test data, summarize the results of the test and compare the results with previous test results. The report shall be submitted to KDHE within 30 days of test completion. The report must include the following:

1. The facility name, location, well identification number and KDHE UIC Permit number of the test well.
2. A well schematic depicting current completion and location of the pressure measuring tool during the test.

3. Test well information including wellbore radius, completed interval and type of completion.
4. The distance between the test well and offset wells completed in the same injection interval and the status of the offset wells during both the injection and shut-in portion of the test. Describe the impact, if any, the offset wells had on the test.
5. Chronological listing of the daily testing activities.
6. A description of the surface readout downhole pressure gauge used including manufacturer and type, resolution, calibration certificate and the manufacturer's recommended frequency of calibration.
7. Date of test.
8. Location of the shut-in valve used to cease flow to the well for the shut-in portion of the test.
9. Time of injection period, type of injection liquid, final injection pressure and temperature.
10. Total shut-in time, final static pressure and temperature.
11. Calculations for the following; including equations used, the equations with the appropriate parameters substituted in them, description of values used in calculations and equations and references for values used:
 - * Radius of test investigation.
 - * Time to beginning of the infinite acting portion of the test.
 - * Horner time to the beginning of the infinite acting portion.
 - * Slope or slopes determined from the Horner plot.
 - * The value for kh/u (transmissibility).
 - * Permeability.
 - * Skin.
 - * Pressure drop due to skin.
 - * Flow efficiency.
 - * Flow capacity.
 - * P_{1hr} (pressure at 1hr).

12. Explanation for any pressure or temperature anomaly.
13. Description of whether system is completion or reservoir dominated and whether the system is homogeneous or heterogeneous, including an explanation of how this was determined.
14. The following graphs must be provided:
 - * Cartesian plot, pressure and temperature versus time.
 - * Cartesian plot of injection rate versus time.
 - * Log-Log and derivative plots with the flow regions identified (must identify radial flow).
 - * Semi-log Horner and expanded Horner plots with flow regions indicated (must identify radial flow), the semilog straight line drawn, P^* (extrapolated pressure) and P_{1hr} (extrapolated pressure at 1hr).
15. A comparison of permeability, Kh/u , skin, P^* and fillup with the same values determined from fall-off tests previously conducted.
16. A statement that the raw test data generated by the test will be kept on file by the permittee for a period of not less than 3 years and will be made available to KDHE upon request during this time period. The raw test data need not be submitted to KDHE unless requested.